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REPORT OF SURVEY CONDUCTED AT

**TOOELE ARMY DEPOT
TOOELE, UT**

SEPTEMBER 1997

Best Manufacturing Practices



BEST MANUFACTURING PRACTICES CENTER OF EXCELLENCE
College Park, Maryland
www.bmpcoe.org

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Foreword



This report was produced by the Best Manufacturing Practices (BMP) program, a unique industry and government cooperative technology transfer effort that improves the competitiveness of America's industrial base both here and abroad. Our main goal at BMP is to increase the quality, reliability, and maintainability of goods produced by American firms. The primary objective toward this goal is simple: to identify best practices, document them, and then encourage industry and government to share information about them.

The BMP program set out in 1985 to help businesses by identifying, researching, and promoting exceptional manufacturing practices, methods, and procedures in design, test, production, facilities, logistics, and management – all areas which are highlighted in the Department of Defense's 4245-7.M, *Transition from Development to Production* manual. By fostering the sharing of information across industry lines, BMP has become a resource in helping companies identify their weak areas and examine how other companies have improved similar situations. This sharing of ideas allows companies to learn from others' attempts and to avoid costly and time-consuming duplication.

BMP identifies and documents best practices by conducting in-depth, voluntary surveys such as this one at Tooele Army Depot conducted during the week of September 15, 1997. Teams of BMP experts work hand-in-hand on-site with the activity to examine existing practices, uncover best practices, and identify areas for even better practices.

The final survey report, which details the findings, is distributed electronically and in hard copy to thousands of representatives from government, industry, and academia throughout the U.S. and Canada – *so the knowledge can be shared*. BMP also distributes this information through several interactive services which include CD-ROMs, BMPnet, and a World Wide Web Home Page located on the Internet at <http://www.bmpcoe.org>. The actual exchange of detailed data is between companies at their discretion.

Tooele Army Depot is a subordinate installation of the Headquarters, U. S. Army Industrial Operations Command. Tooele's three main missions include Ammunition Operations, Ammunition Equipment Design and Development, and Rail Shop Maintenance and on-site support. Tooele, the Western Region Tier I Ammunition Depot, is one of four Tier I ammunition depots that receives, stores, issues, renovates, modifies, maintains, and destroys conventional munitions for all Department of Defense services.

The Best Manufacturing Practices program is committed to strengthening the U.S. industrial base. Survey findings in reports such as this one on Tooele Army Depot expand BMP's contribution toward its goal of a stronger, more competitive, globally-minded, and environmentally-conscious America.

I encourage your participation and use of this unique resource.

Ernie Renner

Director, Best Manufacturing Practices

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Section 1

Report Summary

Background

Tooele Army Depot (TEAD), located in Tooele, Utah, is a subordinate installation of the Headquarters, U.S. Army Industrial Operations Command, Rock Island, Illinois. TEAD's three main missions include Ammunition Operations; Ammunition Equipment Design and Development; and Rail Shop Maintenance and on-site support. TEAD also provides base operations support for tenant activities.

Ammunition storage capabilities at TEAD are one of the largest in the United States. TEAD, the Western Region Tier I Ammunition Depot, is one of four Tier I ammunition depots which receives, stores, issues, renovates, modifies, maintains, and destroys conventional munitions for all Department of Defense services.

The Ammunition Equipment Directorate provides specialized services in ammunition equipment prototype design and development. This ammunition support includes Ammunition Peculiar Equipment used for demilitarization, renovation, modification, modernization, and normal maintenance of conventional-type ammunition, as well as equipment used in the disposal of chemical munitions.

The Defense Nontactical Generator and Rail Equipment Center is located at Hill Air Force Base, 70 miles north of Tooele. This is the only rail over-haul facility in the Department of Defense. Locomotives for military services are overhauled at this location, as well as large rail mounted nontactical generators which are capable of powering small cities. The facility also provides on-site maintenance of Department of Defense locomotives and rolling stock for all services across the nation with its mobile and rail maintenance contract teams.

In addition to the three main mission areas and on-site operations support, TEAD provides base operations support for the Deseret Chemical Depot, the Tooele Chemical Demilitarization Facility, and the Chemical Agent Munitions Disposal System and its activities. TEAD also provides information management services support for the following Army ammunition plants and Army depots: McAlester, Oklahoma; Hawthorne, Nevada; Sierra, California; Crane Army Ammunition Activity, Indiana; Rocky Mountain Arsenal, Colorado; Pueblo Chemical

Depot, Colorado; Umatilla Chemical Depot, Oregon; and TASA — the Television, Audio Visual Support Activity in Sacramento, California.

TEAD employs 510 civilians, two military, and 163 contractor personnel. The Depot owns 25,173 acres of land, 260 buildings, 259 Base Realignment and Closure buildings, and a total of 920 storage igloos, above ground magazines, and warehouses. The total storage capacity at the Depot is 2,483,000 square feet. The Depot has an annual operating budget of \$69,189,000, with an annual payroll of \$38,964,000. Annual local procurement exceeds \$4,500,000.

TEAD headquarters, located 35 miles west of Salt Lake City, Utah, was originally named the Tooele Ordnance Depot and was established at Tooele as a World War II Ordnance Corps installation in 1942. Originally constructed as an ordnance depot, Tooele Ordnance Depot began operations as a storage, supply, and repair depot in March 1947. Tooele Ordnance Depot was later transferred from the jurisdiction of the Chief of Ordnance to that of the Commanding General, U.S. Army Materiel Command, effective August 1, 1962, and was renamed Tooele Army Depot.

TEAD was listed on the Base Realignment and Closure list in 1993. Recommendations were to close and transfer the Maintenance and Supply missions by 1999. This was accomplished nearly four years ahead of schedule due to "fast tracking." TEAD is now actively engaged in transferring the 1,707 acre Base Realignment and Closure parcel to the Tooele City Local Reuse Authority. During the realignment, the Depot downsized from more than 3,000 employees to 624 employees.

TEAD's reuse program has successfully linked Army, state, and local officials to ensure all has been done to expedite transition of the property to the private sector. The Depot's first leasing agreement was signed in November 1995 with Kentuckianna Curb Company, Inc., and nine additional leases were signed in April 1996. The first portion of the excess parcel, which included the 400,000-square foot Consolidated Maintenance Facility, was transferred to the Local Reuse Authority in July 1996 and subsequently sold to Penske Corporation.

Fifteen miles south of TEAD headquarters is the Deseret Chemical Depot. This installation officially

transferred from the Industrial Operations Command to the Chemical and Biological Defense Command on October 1, 1996. Forty-four percent of the nation's stockpile of chemical-filled munitions are stored under high security and safety at this location. The Tooele Chemical Demilitarization Facility and the Chemical Agent Munitions Disposal System are also located at the Deseret Chemical Depot. The Tooele Chemical Demilitarization Facility plant began destruction of the chemical stockpile stored at Deseret Chemical Depot on August 22, 1996.

Major tenant activities at TEAD include the U.S. Army Health Clinic, the U.S. Army Test Measurement Diagnostic Equipment Center, Company C, 4th Light Armored Reconnaissance Battalion, 4th Marine Division, the Utah National Guard, the Department of Defense Printing Service, and the 62nd Ordnance Company Provisional. The BMP survey team considers the following practices to be among the best in government and industry.

Best Practices

The following best practices were documented at Tooele Army Depot:

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Deactivation Furnace	9
The Ammunition Operations Directorate established a work crew to perform daily inspections, munition equipment tests, gas cooling, and block cleaning. The work crew performs these required functions one hour prior to the normal production crew starting times, resulting in a 20% increase in production time during the normal production hours. This increase occurred without increasing overtime man-hours.	
Pilot Model Shop	10
The Pilot Model Division of the Ammunition Equipment Directorate has evolved into an efficient, cost-effective fabrication facility for manufacturing prototype and first production items of Ammunition Peculiar Equipment and other conventional and chemical ammunition-related equipment. Improvements to equipment maintenance, tooling procurement, and manufacturing techniques have made the Pilot Model Shop a major contributor in supporting the worldwide conventional and chemical munitions community.	
Robotics Manufacturing Practices	10
TEAD incorporated the use of robotics in ammunition operations. The use of robotics provides precise, repeatable patterns for stripping hazardous materials and controlling airborne materials. This improves the production quality and removes the operator from a hazardous environment.	
Expertise in Environmental Compliance	11
The Ammunition Equipment Directorate developed a database to predict combustion products and thermodynamic results of various disposal methods. These predictions for demilitarization of munitions can be performed to assess the potential environmental impact and to satisfy the Environmental Protection Agency reporting requirements.	
Chemical Demilitarization Program Support	9
The Ammunition Equipment Division developed, designed, and tested the Rapid Response System for non-stockpiled suspected chemical munitions. The Rapid Response System is a mobile, self-contained unit, designed to deploy on-site to test, identify, and neutralize suspected chemical munitions.	
Broadband Network	12
TEAD utilized Department of Defense excess equipment to upgrade its existing computer network. For a cost of \$134,862, TEAD was able to use its existing cable plant and still provide the graphical user interface required for Windows networking, use of the Internet, and compatible electronic mail.	

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Base Realignment and Closure Clean Up Team	13	Storage Plan	16
TEAD developed a strong partnership with Regulatory members of the Base Realignment and Closure Clean Up Team. This relationship has resulted in the trust and confidence needed to ensure mutual agreement on clean up decisions and action. The willingness of regulatory agencies to provide technical assistance, rather than pure oversight, has proven to be extremely valuable as technical resources have been reduced at the Depot.		Due to large quantities of retrograde ammunition from Europe and Southwest Asia, TEAD created and implemented an improved storage plan. The plan stored like commodities in the same storage block, and stored fast-moving items in close proximity to the shipping facility. The plan reduced times for consolidated shipments as well as produced cost savings from reducing re-warehousing requirements.	
Base Realignment and Closure Experience	13	Straddle Carriers	17
TEAD completed its own realignment directed by Base Realignment and Closure 93. As directed by Base Realignment and Closure 88, TEAD also managed the closing of the Fort Wingate Depot Activity in Gallup, New Mexico, the closing and transfer of the Navajo Depot Activity in Flagstaff, Arizona, and the realignment of the Pueblo, Colorado and Umatilla, Oregon Depot Activities. TEAD also assisted in the closure of the Sacramento Army Depot directed by Base Realignment and Closure 91. This experience contributed to the success achieved by TEAD in managing its own realignment.		Through the use of straddle carriers, TEAD reduced the number of personnel and equipment required to ship and receive ammunition within the Depot job sites. Use of the carriers produced a 50% reduction in ammunition transportation time.	
Field Support of Ammunition Peculiar Equipment	15	Base Realignment and Closure Reuse Efforts	17
TEAD's Ammunition Equipment Directorate improved communications with customers through efficient use of the operator and maintenance manuals. These improvements resulted in an 80% reduction in travel costs to customer locations while maintaining an 82% favorable customer rating.		The 1993 Base Realignment and Closure decision required TEAD to close its maintenance and general supply missions. The Depot faced the task of transferring more than 300 buildings, several thousand acres of land, and thousands of items of property to the Local Reuse Authority. The Depot quickly developed a plan to meet the requirement of turning over excess property to the Local Reuse Authority while continuing its remaining missions of ammunition operations and the ammunition equipment program.	
Hazardous Materials Response Team	15	Commercial Item Approach to Procurement	17
TEAD built a state-of-the-art Emergency Hazardous Materials Vehicle with a 24-foot hazardous materials trailer for less than \$55 thousand. By building its own vehicle, the Depot saved nearly \$155 thousand. Purchasing a custom-built vehicle from the General Services Administration would have cost more than \$210 thousand.		TEAD implemented Section 12.6 and Section 13.6 of the Federal Acquisition Regulation. Section 12.6 provides streamlined procedures for the evaluation of, and solicitation for commercial items. Section 13.6 provides a test program for certain commercial items. Using these Federal Acquisition Regulation provisions together for commercial acquisition, contract awards can be made in a matter of days. Overall benefits obtained to date include enhanced competition, increased teaming, price reductions, and time reductions.	
Issue of Propellant	16	Condition Code-K Inspections	18
Alliant Technologies is a manufacturing company that stores propellant at TEAD. To assure a mutually beneficial business arrangement, TEAD has dedicated storage igloos for Alliant Technologies' use. TEAD has also arranged specific pickup and drop-off times that expedite the process.		TEAD implemented a team to correct problems associated with Condition Code-K ammunition receipts. The team established three main goals — eliminate backlog, generate resource savings of time and money, and have 100% team participation. The team successfully attained its goals realizing a six-month savings of \$168 thousand.	

Item	Page	Item	Page
Credit Card Program	18	management, cost buster initiatives, strategic planning, training, and activity-based costing.	
The International Merchants Purchase Authorized Card is a government-wide commercial credit card used by government organizations for procurement of supplies and services less than \$2,500. TEAD's contracting directorate instituted several actions to increase the credit card usage as well as reducing overall costs. An automated credit card system was developed to consolidate actions within cost centers and control stock accountability. This resulted in an annual savings of \$250 thousand.		Tooele Initiative Program	21
Internet Acquisition Initiatives	19	The Tooele Initiative Program was established to quickly and fairly re-employ disabled and injured workers from the long-term workman's compensation rolls. A Compensation Task Team was formed to design medically acceptable, light duty jobs that would allow claimants to return to work.	
There has been rapid growth in the number of Government Internet sites that provide information or can be utilized to make Department of Defense contracting more efficient. TEAD implemented a procedure to investigate these sites and share the information. When a site is identified, an action officer is assigned to investigate the site and report the potential benefits. A running log of sites, including report status, is maintained and shared, improving efficient use of the Internet and acquisitions at the Depot.		Information	
Mini Stock Record Account	19	The following information items were documented at Tooele Army Depot:	
TEAD developed a Mini Stock Record Account to track equipment that would be released as a result of Base Realignment and Closure mandated downsizing. A standard system to track this equipment did not exist. The Depot benchmarked its system against the Installation Equipment Management System.		Item	Page
On-Site Contractor Safety Store	20	Computer Aided Drawing System	23
TEAD's Safety Office reduced cost and improved customer service through hiring a private contractor to operate a safety clothing and equipment store at the Depot. An analysis showed that the price for goods and services remained significantly less than would occur by obtaining small or individual quantities through purchase orders. The annual cost of equipment purchased, buyer travel, and administration costs are estimated to be \$65 thousand less than by using the Government credit card program.		TEAD installed a Computer Aided Drawing system that is used for approximately 800 engineering drawings per year. The use of the Computer Aided Drawing system reduced drawing preparation time from an average of 40 hours to 20 hours per drawing. Manpower has been reduced from 12 draftsmen to five Computer Aided Drawing operators, while maintaining the 800 drawing workload.	
Retreats	20	Preparation of Simulated Munitions	23
TEAD conducts retreats for Directors, Division Chiefs, and Special Staff personnel. The quarterly retreats are conducted away from the job site to allow the participants to concentrate on areas such as team building, total quality		TEAD has a history of providing simulated munitions to customers in a timely and cost-effective manner. Inter-service customers often draw on TEAD's expertise to prepare simulated munitions. TEAD has a vast technical library of ammunition specifications dating from the 1940s, and a unique inventory of inert and live ammunition components.	
		Ammunition and Equipment Testing	24
		TEAD has the capability to conduct non-destructive testing of high explosives, chemical munitions, and various hazardous wastes. The testing can be utilized by government and non-government agencies for new products and equipment.	
		Ammunition X-Ray	24
		TEAD is certified to perform x-ray examinations on 40 millimeter M430 and M383 cartridges. The Depot received a contract to examine one million rounds per year. TEAD developed a system to perform x-ray imaging of linked belts of the M430 and M383 cartridges on a continuous basis.	

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Cafeteria Lease to Detroit Diesel	24	Federal Express Powership	26
The 1993 Base Realignment and Closure actions closed TEAD's Combined Maintenance Facility. The Combined Maintenance Facility was transferred to the city of Tooele and then sold to Detroit Diesel. TEAD had an outstanding loan for the cafeteria attached to the Combined Maintenance Facility. To repay the loan, the Depot leased the cafeteria to a food service vendor.		TEAD implemented the Federal Express Powership program. Federal Express provided a computer, software, and a printer free of charge. In doing so, the Powership program reduced paperwork and established a central pickup point and time. The Depot saved \$10,500 in one year by using the Powership program.	
Less than TruckLoad Shipping	25	Inert Storage	26
TEAD built a new Less than TruckLoad facility that has greatly increased the efficiency of providing Less than TruckLoad shipments. The new facility reduced intra-depot movement of ammunition and eliminated demurrage charges.		The 1993 Base Realignment and Closure actions eliminated TEAD's general supply mission. TEAD gained approval to retain some of the general purpose warehouses instead of transferring them to the Local Reuse Authority. These warehouses were then used for storage of inert materials, thereby opening additionally needed igloo storage space for explosives.	
Reuse of Telephone Switch	25	Intel 16 Shipping Database	27
TEAD's telephone system network had deteriorated to the point that daily failures were common. Due to the age and the design of the system, replacement parts were becoming increasingly difficult to procure. Complete replacement was cost prohibitive. The Depot located and acquired a used switch array system from within the Army's excess equipment listings. The acquisition of the used system produced a \$1 million savings over new procurement.		TEAD created a database on the Intel 16 mainframe that contains the shipment planning worksheet number, commodity type, transportation control number, Government Bill of Lading, weight, cube, quantity, and carrier. This database provides an effective management tool that quickly provides shipping information.	
CONUS Freight Management System	25	Social Services Joint Cooperation Agreement	27
TEAD implemented the CONUS Freight Management System to the maximum extent. The application of CONUS Freight Management eliminated the long delays to receive commercial carrier rates and routes from the Military Transportation Management Command. This information is now received in less than one hour. CONUS Freight Management provides the Government Bill of Lading, electronic Transportation Discrepancy Reports, and carrier performance reviews.		The Army Community Services at TEAD entered into agreements with the local community to coordinate resources and services of all agencies to provide a healthy, safe environment for its constituents and their family members. The combined services of TEAD's Army Community Services have proved essential in maintaining an effective program during current downsizing efforts.	
Direct Sale Authority of Recyclable Material	26	Base Realignment and Closure Clean Up Team, Fort Wingate Depot Activity	27
In 1996, TEAD received authority to conduct direct sales of scrap and recyclable materials. Under direct sales authority, the Depot receives payment in 30 days or less. This is a significant reduction from the nine to 12 months experienced through the Defense Reutilization and Marketing Services.		As a result of the President's plan, a Base Realignment and Closure Cleanup Team was formed at Fort Wingate Depot Activity, New Mexico. The Base Realignment and Closure Clean Up Team is responsible for 45 environmental sites. Use of the Base Realignment and Closure Clean Up Team improved communication among all involved parties, eliminated duplication of effort by participant agencies, and provided a proper exchange of information with a reduction in document review time.	

Item	Page	Item	Page
Cost Busting Initiatives	28	customers. The Ammunition Equipment Directorate works closely with the Industrial Operations Command and the Ammunition Peculiar Equipment manager to quickly develop, budget, and fund a project and provide the required equipment and technical support in a timely manner.	
Customer Feedback	28	Maximizing Demilitarization Capability	30
To improve quality and instill customer satisfaction, the Defense Nontactical Generator and Rail Center created a customer evaluation feedback program. The customer survey is a critical correction tool to improve quality and customer satisfaction.		State imposed environmental and noise constraints have placed restrictions on TEAD's open detonation pit and burn pan demilitarization capability. As a result, TEAD focused more of its demilitarization efforts on the Ammunition Peculiar Equipment 1236 deactivation furnace, the contaminated waste processor, teaming with private industry, and improving its Recycle, Recover, Reuse capability.	
Hazardous Materials Management Program	29	Meeting Workload Requirements with Minimum Staffing Levels	31
TEAD developed a management program to record the hazardous materials used by Ammunition Operations Directorate. Through this program, the Depot increased information available for planning work requirements, increased inventory control, reduced environmental impact, and lowered personnel health risks.		TEAD is able to provide the required level of fire protection with minimum staffing. TEAD's Fire and Emergency Services Division also serves as the Primary Staff Duty Officer during regular non-duty hours, saving the Installation \$250 thousand in FY 1997.	
Hazardous Waste Tracking	29	Partnership with Private Industry	31
TEAD has a permit to operate as a hazardous waste storage facility. This requires the Depot to maintain detailed records and submit periodic reports. Using commercial software, the Depot created an automated Hazardous Waste Tracking System. The new system is user friendly, thereby simplifying record keeping and reducing report preparation times.		TEAD is conducting on-going discussions with private industry concerning a number of partnership concepts. The Depot identified tasks that could not be conducted by private industry; the remaining tasks were areas to consider for partnering. The Depot focused its partnering efforts on the recycle, recover, reuse program.	
Joint Use of Morale Welfare and Recreation Facilities	30	Patrol Acreage vs. Staffing Levels	31
TEAD entered into a joint use agreement with the community of Tooele to use Morale, Welfare, and Recreation facilities. The agreement allows the community to use the softball fields, riding stables, basketball courts, swimming pool, travel camp, archery range, rifle range, trap and skeet range, gazebo park, and the bowling center for a fee. The community may also participate in Morale, Welfare, and Recreation sponsored events.		As a result of rightsizing initiatives, TEAD compared its security program to the basic security requirements of the applicable Army Regulations. By eliminating processes that exceeded the basic regulatory requirements, the Depot was able to reduce security staffing and showed a projected \$203 thousand in savings during the next three years.	
Matrix Cost Estimating	30	Project Management Improvements	32
The Ammunition Equipment Directorate follows a formalized proposal process. The process consists of estimating labor hours, material cost, and travel required to provide equipment and technical support requested by inter-service		The Ammunition Equipment Directorate is in the process of establishing a Project Review Board to provide technical oversight of a project throughout the development cycle. The oversight by the Project Review Board is expected to result in the best possible technical solution being implemented to satisfy customers' requirements.	

Item	Page	Item	Page
Project Matrix Management	32	Strategic Planning	34
The Directorate of Ammunition Equipment implemented Project Matrix Management to conduct business for current and future workloads. The matrix management will be project-driven rather than organizationally-driven. Expected benefits include increased project efficiency, workforce synergy, flexible workforce assignments, workforce cross training, and employee empowerment.		TEAD has begun developing and implementing a formal strategic planning process. The process was initiated by the Government Performance and Results Act of 1993. The process utilizes a cyclic method that helps complex organizations make strategic decisions.	
Project Proposals	32	Teaming	34
The Ammunition Equipment Directorate developed a Matrix Cost Estimating method using a commercial spreadsheet software package. This method allows the Ammunition Equipment Directorate to define each task that must be completed to comply with the customer's request, and also defines the associated cost of completing the task. Pricing information is available in a timely and efficient manner.		TEAD's Directorate of Ammunition Operations is departing from a traditional hierarchical organization and implementing cross functional teaming. The team structure provides for a cross functional organization and allows those with the most intimate process knowledge to be an integral part in suggesting and implementing improvements.	
Recurring Contract Requirements	33	Worker's Compensation Claims Review Board	35
The TEAD contracting office developed an automated procedure to notify requisitioning organizations of expiring purchase orders. The organization then has 30 days to renew the purchase order. This procedure has provided enhanced continuity of supplies, services, and deliveries.		TEAD has a Federal Employee's Compensation Act Claims Review Board. The board instituted many initiatives to prevent and reduce injuries such as training, fitness programs, safety awareness, and team building.	
Reduction in Depreciation Costs	33	Point of Contact	
To reduce overhead costs, TEAD reviewed equipment usage and eliminated many non-mission essential items. The Depot will continue to monitor and challenge new purchases and equipment requests. Efforts to date have saved the Depot an estimated \$800 thousand in depreciation costs.		For further information on items in this report, please contact:	
Specialty Skills	33	Mr. Rodney J. Huff Director of Ammunition Operations Commander Tooele Army Depot Attn: SIOTE-AO Tooele, Utah 84074-5021 Phone: Commercial (435) 833-2181 DSN 790-2181 Fax: Commercial (435) 833-3192 DSN 790-3192 E-mail: huffr@tooele-emh2.army.mil	
The Ammunition Equipment Directorate maintains specialty skills in the design, development, testing, fielding, and technical documentation of equipment for demilitarization and renovation of conventional ammunition. The Ammunition Equipment Directorate provides training in the properties, uses, and effects of explosives and ammunition. Personnel have received the appropriate safety and environmental training to meet all Occupational Safety and Health Administration and Environmental Protection Agency requirements.			

Section 2

Best Practices

Design

Remote Control and Autonomous Vehicles

TEAD's Ammunition Equipment Directorate (AED) is the original developer of the remote control and autonomous vehicles used in the Unmanned Ground Vehicle (UGV) Program for the Army Research Laboratories. This effort covers a period of 17 years, and is supported by funding from the Office of the Secretary of Defense and the Advanced Research Projects Agency.

During the first demonstration phase of the UGV program, which began in 1992, AED successfully transitioned industrial remote control and robotic techniques to fielded systems. An automated tracking control system and a laser targeting and shooting system were demonstrated.

AED was also a participant in providing robotic technology training to nine user groups, which included private industry. This led to a second demonstration phase of the UGV program where Marine and Army troops conducted UGV operations in three tactical scenarios. The significant accomplishments for this phase were:

- First semi-autonomous scout UGVs
- First demonstration of three cooperating UGVs
- First demonstration of three different types of UGVs in an urban terrain mission
- First three-kilometer tactical unmanned maneuver
- First UGV supported adjustment of mortars
- First Battle Lab War Fighting Equipment using UGV technology
- First no personnel loss UGV experiment

At present, AED provides technical and developmental support for remote equipment used by Jet Propulsion Laboratories, National Institute of Standards and Technology, Human Research Engineering Directorate, and Harry Diamond Laboratories.

Test

Chemical Demilitarization Program Support

The AED has supported the Program Manager for Chemical Demilitarization with a variety of equipment for 28 years. The AED has a long history of providing the development, fabrication, and testing of chemical demilitarization equipment throughout various sites. Recently, the AED developed, designed, and tested the Rapid Response System (RRS) for non-stockpiled suspected chemical munitions.

The RRS is a mobile, self-contained unit designed to go on-site to test, identify, and neutralize suspected chemical munitions found in various non-stockpiled CONUS locations. Most of these sites are decommissioned, ex-military locations. Many of these items have been abandoned for several years, some for several decades. The key to the RRS has been the use of RAMAN Spectrophotometer technology to identify the agents in suspected chemical munitions. This system has a vast potential for use in a variety of non-Department of Defense (DOD) applications such as the identification of hazardous waste at building construction or building renovation locations.

Production

Deactivation Furnace

In 1995, TEAD experienced trouble sustaining a production rate on demilitarization of items in the Ammunition Peculiar Equipment (APE) 1236 M1 Deactivation Furnace. The unpackaging of items to be destroyed and the cleaning of the coolant blocks on the Air Pollution Control System were main contributors for non-productive hours.

TEAD began burning the inner-packaging material along with the munitions to be destroyed through the furnace. This solved the unpackaging time and increased the feed rate to the furnace. This procedure increased production 20%, although the furnace required more frequency in cleaning due to the packaging material residue.

TEAD solved this problem by changing the crew start times. The shift was split by starting one person one hour earlier than the rest of the assigned personnel. This individual's tasks were to perform equipment tests, start the furnace (start-up time to function is approximately one hour), and unpackage items from outer packs. The remainder of the assigned crew reported with start-up responsibilities being minimal. This procedural change allowed the furnace to run for half the shift and then be shut down for cleaning. Cleaning time and start-up would take one hour. The furnace would be in operation again for the duration of the shift.

During a program in which TEAD was demilitarizing cannon primers, the production rate was increased to 45,000 cannon primers on a daily basis (from 18,000 to 22,000). This increase was reached without additional manpower or overtime.

Pilot Model Shop

The Pilot Model Division of the AED has evolved into an efficient, cost effective fabrication shop. The major mission of the Pilot Model Shop is to manufacture or fabricate prototype and/or first engineering production of APE and other conventional and chemical ammunition-related equipment. Drawing from more than 300 man-years experience, the Pilot Model Shop successfully enhanced its equipment maintenance, machine tooling procurement, and manufacturing techniques. These improvements have made the model shop a major contributor in supporting the worldwide conventional and chemical munitions community.

In the equipment maintenance area, the Pilot Model Shop developed in-house maintenance capabilities for servicing its 80 machines (valued at more than \$1.6 million). Several are Computer Numerical Control (CNC) machines and require complex, specific service. Because of this in-house capability, the overall condition of the machinery (ranging in age from eight to 54 years) is excellent, and downtime has been kept to a minimum. CNC equipment repair cycles that were typically two to four weeks have been reduced to an average of eight to ten hours.

Recognizing that performance is critical in the procurement of machine tooling, AED has gone to proven suppliers and products. By being selective in tooling purchases, the total costs associated with manufacturing have been reduced over the years in man-hours, cutting and milling times, and tool breakage. By utilizing the government credit card purchasing capability, AED has access to local tool

suppliers who are very responsive to its needs. This has also reduced the spares inventory requirements.

In 1993, the Pilot Model Shop procured a CNC WaterJet cutting system from Flow International, Kent, Washington for \$225 thousand. This system was obtained to manufacture irregularly shaped components. Operating at up to 50,000 psi, the system will cut components from steel, aluminum, plastic, and rubber up to 4 inches thick with little or no finishing required. Sheet metal items, such as elbows, transitions, and flanges are significantly simpler to manufacture as precise cuts of arcs and curved pieces are possible. This equipment has reduced the manufacturing time of milled and machined components up to 50%. Additionally, material costs have been reduced with less waste from milling or machining, and reduced charges by suppliers for special or complex cuts have been realized.

Robotics Manufacturing Practices

TEAD's AED utilizes robotics in ammunition operations for handling projectile disassembly, defusing, paint stripping, and removing asbestos coating. Robotic applications provide precise, repeatable, and high quality operations that improve productivity and remove the operator from potentially hazardous environments.

The number one priority to the demilitarization operations is operator safety. Factors such as weapon composition, environmental conditions, and operator fatigue enter into the formulation of demilitarization procedures. Facilities, equipment, and techniques are designed to assure safety, such as the use of special equipment enclosures and operator protective clothing to perform the operations. The cost is high to assure safety while maintaining high quality operations.

At AED, the utilization of robotics in ammunition operations has both improved operator safety and been cost effective. The following projects are examples incorporating robotics into demilitarization operations:

- Bomb Asbestos Removal — An APE 2207 robot, fitted with a waterjet end effector, was used to strip asbestos coatings from Navy bombs for repainting. This was done to allow Navy bombs to be used by the Air Force at a fraction of the cost for new build. The robot application replaced the operator, improved safety, drastically reduced clean up costs, reduced the cost of expensive clothing and respirators, and reduced safety barrier requirements. Additionally,

process time was reduced from 55 minutes to 15 minutes per each of the more than 1,000 five hundred-pound bombs and 1,000 one-thousand-pound bombs.

- Missile Asbestos Removal—An APE 2207 robot, fitted with a waterjet end effector, was used to strip asbestos from the Titanium Flight Control Generators used in missiles. This was done to allow recycling of the titanium. The robot application replaced the operator, improved safety, reduced safety barrier requirements, and improved productivity.
- Paint Removal — An APE 2207 robot, fitted with a waterjet end effector, was installed at Naval Surface Warfare Center, Crane, Indiana to strip paint and other hazardous materials from bombs. The robot application provides precise, repeatable patterns for paint removal and improved productivity.
- Handling Munitions — An APE 2207 robot, in conjunction with an APE 1001 vertical pull-apart machine, have been used in AED test facilities to handle the 105mm High Explosive Rocket Assisted Projectile in demilitarization operations. The robot application replaced the operator, improved safety, increased productivity, and reduced safety barricade requirements.
- Handling Munitions — An APE 2200 robot was used to feed projectiles on an ammunition line at TEAD to feed three APE 1002 Dual Spindle Defusing Machines. The robot application reduced the number of operators by two, improved safety, and reduced safety barricade requirements.

Robotic applications by AED have focused on providing precise, repeatable, and high quality operations that improve productivity and remove the operator from potentially hazardous environments. The expertise demonstrated by AED for intelligent use of robots in highly applicable situations continues to be an available resource for other applications in munitions operations at TEAD, as well as manufacturing operations throughout the federal government.

Facilities

Expertise in Environmental Compliance

The AED developed a database system that allowed TEAD to reduce its Environmental Protection Agency (EPA) compliance costs by 90%. Under

the Resource Conservation and Recovery Act, EPA regulations state that a full analysis of waste materials and an assessment of its impact on the environment must be completed prior to a company being granted a permit for disposal. Due to a lack of in-house expertise in this area, companies must often hire environmental consulting firms to perform the required analyses. This is a time consuming and expensive process. The results of these analyses do not take into account the method of disposal or the original manufacturing process (i.e., welding), which can affect the type of hazardous emissions during the disposal process.

Under the direction of the Defense Ammunition Center, the AED developed a database to predict the combustion products and thermodynamic results of various disposal methods. These predictions can be performed to assess the potential environmental impact of disposal and to satisfy EPA reporting requirements. Through the use of the database, named MERLIN, the AED provides the ammunition community the unique service of making predictions for the demilitarization of munitions. AED is known worldwide as an expert in environmental compliance of munitions disposal systems.

MERLIN is a PC-based software program that is fully compatible with the U. S. Military MIDAS system, which catalogs information on munitions to the ingredient level. MERLIN uses MIDAS or other sources of data to define the chemical makeup of the product to be disposed. MERLIN can also be used to evaluate the thermodynamic and hazardous properties that will result during incineration, open burning, detonation, and other waste handling processes.

To obtain a permit to dispose of a single waste item, the cost could be as much as \$1,000 per week for a company to hire a consulting firm to perform the analysis required to comply with EPA regulations. A five-week process would cost \$5,000. MERLIN can be used to perform the required analysis in approximately one week at an estimated cost of \$500. This process time will be reduced as MERLIN becomes more automated. Currently, calculations that relate to the method of disposal are done by hand. As funding is made available, AED will add features to MERLIN allowing these calculations to be done automatically.

AED's current customers are military bases and government activities having munitions disposal requirements. However, a tool such as MERLIN can be utilized by any industry having waste handling and EPA compliance issues.

Broadband Network

During the process of analyzing TEAD's data and communication network with the intent to acquire Internet access capability, it was determined that the system in use at that time was not capable of providing a graphical user interface. This system, installed during 1985 to 1986, was a TRW network that was no longer supported by this supplier. The system was only capable of text (ASCII) transmission/reception at 19.2 baud (19,200 bits per second). However, the Depot did have a dual broadband frequency modulated cable television internetwork available that would transmit and receive video data on separate cables. This could be adapted for fast ethernet transmission, allowing for video transmission (Internet).

Due to funding constraints that prevented the procurement and installation of a new ethernet network, the decision was made to modify the existing network hardware. The addition of a dial-in Ethernet Network Device, a 16-bit slot hub chassis, and an RF-Networks "Ethernet on Broadband MODEM" allowed the system to use Windows-based applications such as cc:mail, World Wide Web browsers, File Transfer Protocol transmission/reception, Website development, etc. A comparison of the network before and after modification is shown in Figure 2-1. The Operating System used is Windows New Technology with Windows 95 client software.

The cost of the modification was \$36 thousand, while the cost of a new infrastructure would have been \$391,352. A savings of \$355,352 was achieved.

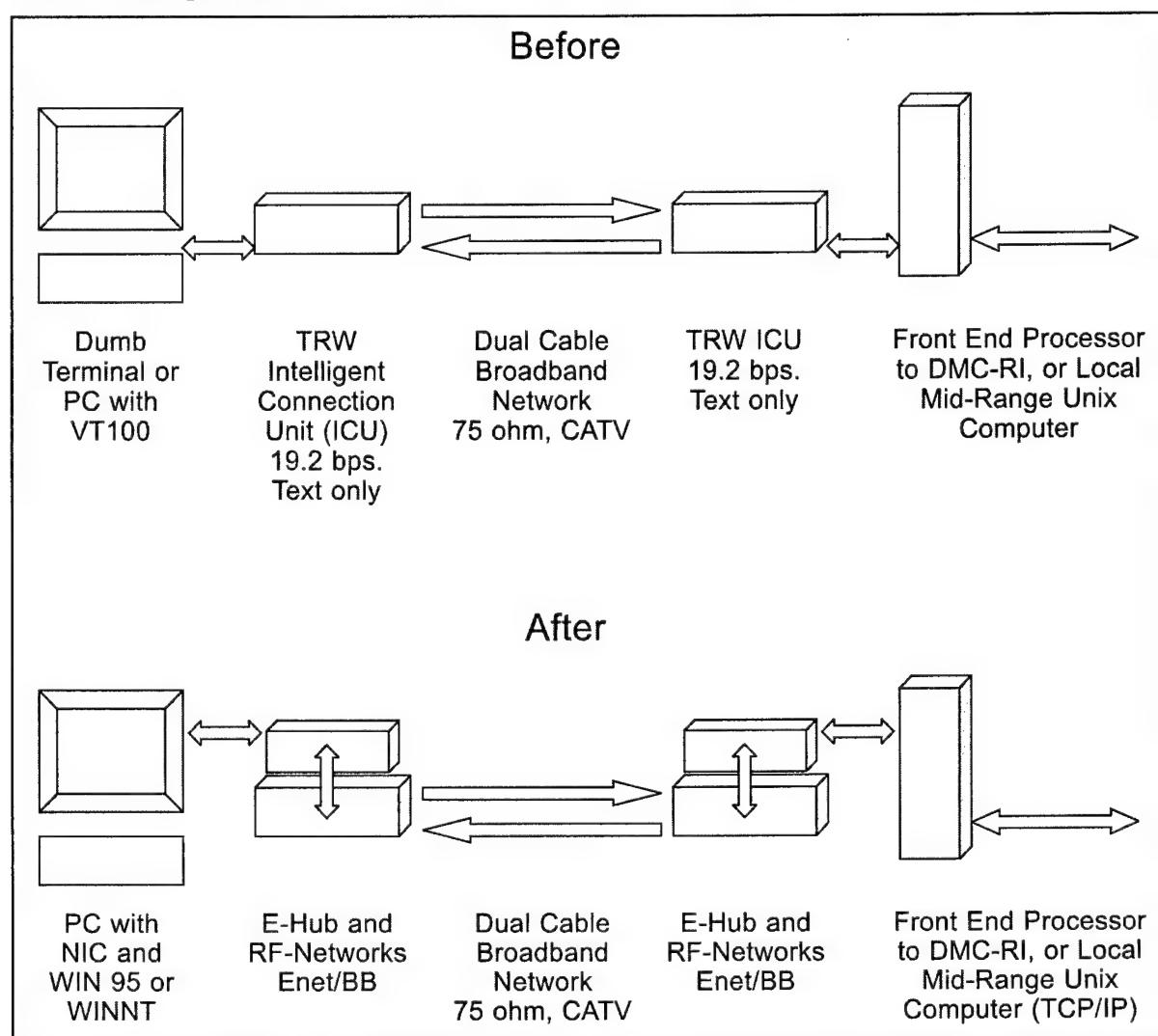


Figure 2-1. Broadband Network Reuse: Before and After

Base Realignment and Closure Clean Up Team

TEAD was realigned under the Base Realignment and Closure (BRAC) 93 review. This was a realignment of the maintenance mission of the Depot and not a total closure. Two parcels of the Depot were excess — the industrial area and the administration area. These parcels contain more than 200 buildings and facilities. A BRAC Clean Up Team (BCT) was established at TEAD in April 1994. The mission of the team involved compliance with environmental activities during closure of the parcels, environmental restoration and corrective actions, environmental assessments and impact statements, and real estate support activities and baseline surveys to support reuse. A total of 57 sites at TEAD are being investigated for environmental restoration requirements or are already undergoing remediation.

A key to the success and effectiveness was the strong partnership that developed between the Army and regulatory members of the BCT. Typical BCTs have three representative members — one from the Installation, one from the state, and one from the EPA. The TEAD BCT had six members — one Installation representative, three state representatives, and two EPA representatives. An excellent working relationship was established among the members which resulted in trust and confidence enabling coordination, timely concurrence on actions, and the ability to make changes in the field when needed. The partnership facilitated fast track clean up for early reuse of excess property. One example of this was the clean up of 25 solid waste management sites, 16 of which were identified prior to the BRAC decision and nine of which were identified after. The BCT members worked together to modify the process by combining phased activities, identifying requirements in the field, and minimizing the preparation of sampling plans and reports. This eliminated one year from the project and put all the sites on the same time line. The willingness of the regulatory agencies to provide technical assistance rather than pure oversight has proven to be extremely valuable as technical resources at the Depot have been lost due to downsizing.

An excellent innovation of the BCT was the development of an Environmental Baseline Database (EBD). The EBD was developed by an independent contractor specifically for TEAD. It provides extensive background data and site histories including facility descriptions, historical use of facilities, solid

waste management units, hazardous waste, hazardous materials, radiologic substances, ground water, asbestos, polychlorinated biphenyls, lead-based paint, air emissions, radon, ordnance and explosive waste, storage tanks, and spills and releases. This information is needed for leasing and transferring buildings and facilities to the local reuse authorities. The EBD provides rapid access to detailed information about each site which greatly speeds up the process and meets the needs of regulators, facility managers, and local reuse authorities.

Base Realignment and Closure Experience

The TEAD BRAC experience is an example of a very effective approach to compliance with the requirements and intent of the BRAC decisions to realign or close TEAD and other installations supervised by TEAD. Besides completing the realignment of TEAD as directed by BRAC 93, TEAD managed the closing of the Fort Wingate Depot Activity in Gallup, New Mexico, the closing and transfer of the Navajo Depot Activity in Flagstaff, Arizona, and the realignment of the Pueblo, Colorado and Umatilla, Oregon Depot Activities. All of these actions were the result of BRAC 88. TEAD also assisted in the closure of the Sacramento Army Depot directed by BRAC 91. All this experience contributed to the success achieved by TEAD in managing its own realignment.

The BRAC 93 Commission's decision to realign TEAD included moving the Depot's maintenance workload to other installations and the private sector; retaining the conventional ammunition and chemical missions; and inactivating, transferring, or eliminating activities of the Depot not associated with the remaining missions. Some tasks such as the maintenance mission completion, Consolidated Maintenance Facility (CMF) transfer, and the excess property transfer were put on a fast track accelerated time line. TEAD committed to transition in a timely manner that would be transparent to the needs of the Depot's customers. TEAD committed to working closely and cooperatively with the local community and regulatory agencies on reuse. Above all, care of the Depot's people was the most important concern to ensure a "transition with pride."

Careful planning was necessary to meet the time line requirements. A closure/realignment plan was developed which established funding requirements, workload transfer dates, shipping schedules, stop-

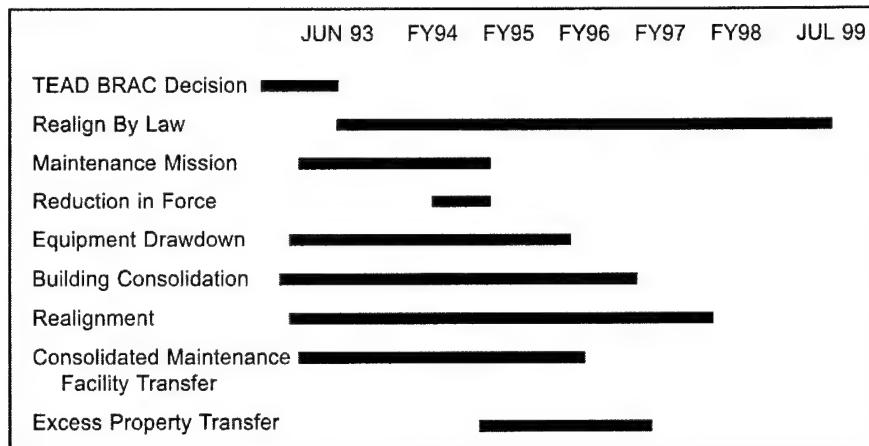


Figure 2-2. BRAC Time Lines

page of incoming shipments, and coordination with Defense Logistics Agency (DLA) and other tenant activities. Other plans included a building closure plan, an equipment disposal plan and a reduction in force schedule. Funding planning was an integral part of the implementation plan to identify requirements for civilian severance, personnel moves, equipment transfer, building deactivation, and environmental actions. The amount of funding available for the realignment was not an issue because only one other Army installation was affected by BRAC 93. However, getting the funds expended in the time frames needed to meet planning windows was difficult. Figure 2-2 shows the BRAC time lines for the realignment.

Transfer of the maintenance mission began in June 1994 with planning to establish time lines and destinations for mission transfer. Equipment transfers to gaining depots began in June 1994 as well. The CMF was closed in October 1994, and maintenance production ceased in April 1995. By May of 1995, the maintenance mission at TEAD was officially complete. The entire job was fast tracked and completed in two years which was four years ahead of schedule.

One of the most difficult parts of the realignment was the downsizing of the workforce. This was done with great care and consideration for the needs of the personnel affected. Figure 2-3 shows the reductions in personnel from March 1993 until October 1997. The reduc-

tions were achieved primarily through job abolition, retirements, reductions to lower grades, and reassignments. Only 177 separations were needed to accomplish the personnel reductions. TEAD employees were provided with excellent transition assistance which included individual transition counseling, referrals to service providers, job information resources and assistance, and follow-up. A Utah state rapid response team provided dislocated workers

workshops, job service opportunities and retraining, and employment assessments and skills testing. A Department of the Army Job Assistance Team provided job search skills training and stress management assistance. Job training grants totaling \$3.2 million were provided by the Federal government, and 192 TEAD employees participated. The Career Center provided automated job assistance, bulletin boards, resume assistance, and a reference library. As a result of these measures, 811 employees found new positions.

The transition of excess property to the local community was placed on a fast track time line using the President's Five Part Plan for Rapid Reuse. The elements of this plan included emphasis

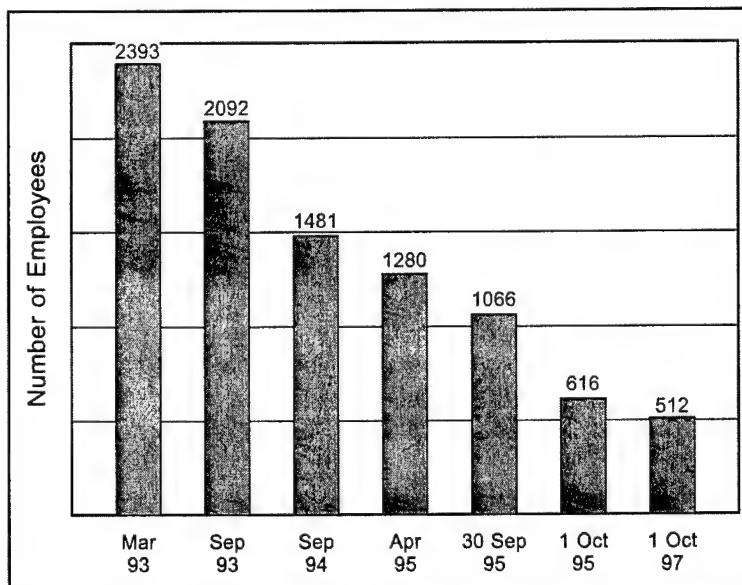


Figure 2-3. BRAC Downsizing

on local redevelopment as the first priority, fast track clean up using a common sense approach, appointment of a Transition Coordinator as the single point of contact for cutting red tape, streamlined requirements for obtaining help and assistance, and acceleration and increased availability of larger economic development planning grants averaging \$1 million over five years. The BRAC Environmental Coordinator worked in close cooperation and partnership with state and federal regulators and the local reuse authority. These measures and the effective working relationships formed among all the participants resulted in a successful and rapid transition. Major successes included the signing of 12 interim leases by November 1995, early approval of the Economic Development Conveyance, transfer of the CMF to Detroit Diesel Corporation in July 1996, and signing of a lease in furtherance of conveyance of the remainder of the property in September 1997.

TEAD learned many valuable lessons for installations undergoing realignment or closure. One of the most important lessons is to establish effective working relationships and rapport with all of the organizations involved. Other important lessons include:

- Final closure actions should be programmed for the summer months for less disruption.
- Bridging meetings are essential to assure that customers continue to be supported as missions draw down.
- Early consultation with the appropriate historic property office is essential as is early contact with environmental clean up participants and regulators.
- Place personnel who find ways to get things done and are prepared to be creative, in key positions; expect to begin to lose key personnel; and begin immediate cross training of personnel in key areas.
- Closure and layaway of buildings should begin as soon as possible.

Effective management, planning, and cooperation with outside agencies facilitated a successful fast tracked accomplishment of the BRAC objectives for TEAD. In spite of the short time line and the overwhelming size of the task, the realignment was accomplished with very smooth reductions in personnel achieved through caring and effective employee assistance programs. The result was a successful realignment, new economic development opportunities for the local community, and a lean and efficient post-BRAC organization for TEAD.

Logistics

Field Support of Ammunition Peculiar Equipment

The AED supports nearly 4,000 pieces of APE worldwide. Currently, 13 equipment specialists are responsible for providing technical support and troubleshooting of this equipment. In the past, TEAD needed about 156 work weeks per year for the AED to fulfill its technical commitment to various customers. This was time consuming and expensive. The Directorate made a concerted effort to improve communications with customers which has drastically reduced travel time and associated travel costs. The current travel commitment is 26 work weeks per year, or a reduction of 80% in travel.

The key to improving communications is the efficient use of the operator and maintenance manuals provided by TEAD when equipment is delivered, and resolving problems with the most knowledgeable worker at the site. This person is usually the operator, not the management or engineering staff. Most field support can now be effectively accomplished by telephone instead of sending technicians to the field. The effectiveness of this approach is proven by the favorable customer survey rating of 82% provided to TEAD in the spring of 1997. The improved communication has provided tremendous benefits for the AED through reduced costs and enhanced customer satisfaction.

Hazardous Materials Response Team

TEAD is a storage location and much of that storage is in the form of hazardous materials. The need for a unit to be available in case of an emergency spill, etc. is a necessity. In 1989, TEAD's Fire Department received tasking for Hazardous Material (HAZMAT) Emergency Response. Prior to 1989, the area could only be secured and clean up provided for the spill. This was accomplished using a fire truck which did not have the proper equipment. Now TEAD maintains an Emergency Response Vehicle with a 24-foot HAZMAT Trailer. The trailer's conception, design, and manufacture were performed by TEAD.

The first plan discussed involved purchasing a General Services Agency (GSA) custom-built vehicle that would cost more than \$210 thousand. This plan had drawbacks — the most obvious being the price. Additionally, as a GSA vehicle, it would be

subject to rotation, meaning with every set number of miles or specified length of time, the vehicle would be stripped and replaced. Other plans were discussed and the plan to emerge victorious involved the Property Disposal Office recoup of a twin engine fire truck which would be retrofitted on post.

Personnel from the Sheet Metal Shop fabricated an aluminum camper shell and did complete re-wiring, while the Maintenance Paint Shop painted it white. The Depot Sign Shop did the finishing touches to include logos and detail work. Special equipment on the Emergency Response Vehicle includes a cellular telephone, fax machine, manuals, and a radio which is hooked into the local county's system. The computer on board has all Material Safety Data Sheets (MSDSs) and CHEMTREC, a nationwide emergency database, that gives the most up-to-date information on hazardous materials. The 24-foot HAZMAT Trailer contains the five-step decontamination facilities. Standard equipment includes self-contained breathing apparatus and other personal protective equipment suitable for a variety of emergencies. The cost for this Emergency HAZMAT Vehicle with 24-foot HAZMAT Trailer was less than \$55 thousand.

The fire department on the Depot acts as caretaker of this vehicle and has the capability of having a response team on a scene within minutes of an incident. This highly trained Hazardous Materials Response Team (HMRT) also provides support to Deseret Chemical Depot (DCD) with a response time of 18 minutes. By having only one HMRT versus two, TEAD and DCD saved more than \$240 thousand the first year of operation.

The Emergency HAZMAT Vehicle is a state-of-the-art hazardous materials response truck that was locally fabricated for only \$55 thousand versus \$210 thousand. The vehicle will improve TEAD's capability in minimizing the loss of life and property, and due to the quick response time, will reduce the danger to the environment.

Issue of Propellant

Alliant Technologies is a manufacturing company that stores propellant at TEAD. By cooperating, TEAD and Alliant Technologies now have an excellent working relationship. In the past, many problems existed with the process. For example, receipt and issue coordination was unreliable, no dedicated storage igloos existed, and propellant barrels were received in a loose pack configuration.

Alliant Technologies and TEAD started working together by scheduling specific delivery and shipment dates. Alliant comes to TEAD every Tuesday morning, before any other commercial carriers arrive, to pick up propellant. Every Wednesday morning, TEAD receives a new shipment of propellant. By scheduling, TEAD's shipping crew is prepared with forklifts and support equipment waiting at the igloo. The propellant leaves TEAD in a First In First Out (FIFO) rotation schedule. Alliant Technologies takes care of all paperwork and record keeping, so the company knows what lot numbers are stored at TEAD and how long they have been there, keeping the FIFO rotation schedule valid.

TEAD's shipping and storage crew cleaned out 13 storage igloos to be used exclusively for Alliant Technologies' propellant. This required significant rewarehousing to maximize the storage space available at TEAD. Alliant now palletizes the propellant barrels by using a mesh wrapping. This simple configuration change saved TEAD 182 hours of work per year which equates to more than \$14 thousand per year.

Many benefits resulted from the working relationship between Alliant Technologies and TEAD. Operations are now more efficient, inventory control has increased, costs have been reduced, and scheduling has minimized down time.

Storage Plan

In 1992, large quantities of retrograde ammunition from Europe and southwest Asia were being received at TEAD. At that time, the Depot had two empty storage sites. Although it had adequate storage space throughout the ammunition area, TEAD realized there was no control over placement of receipts for consolidation according to types of ammunition or location of facilities. In effect, no storage plan existed.

Keeping the need for improvement in mind (e.g., storing like commodities together to gain maximum utilization), TEAD began a storage strategy by implementing a vast rewarehousing effort and re-defining the process to gain control of receipts. TEAD designated different blocks of storage sites for different types of ammunition. Fast moving items are stored in close proximity to the Less than TruckLoad (LTL) shipping facility. Like commodities are stored in the same storage block, reducing time frames for consolidating shipments. The plan has been fully communicated to the workforce in the ammunition area, thus ensuring buy-in to the plan.

By organizing the storage of ammunition in more than two million square feet of storage space, TEAD realized the inherent cost savings that come with a good storage plan. TEAD optimized the use of limited rewarehousing funds, and managed the storage of receipts to accomplish its plan.

Straddle Carriers

Prior to procuring Straddle Carriers, TEAD used a traditional arrangement to receive, move, and issue ammunition. A crew of five to six personnel used a truck and trailer for moving forklifts, and one to two tractors and trailers. The crew required two forklifts, but the trailer could only haul one at a time, requiring multiple trips to set up at a job site. A standard box van was used to haul the ammunition and took substantially longer to load than the straddle carrier.

Equipment currently being used by TEAD for movement of material for shipment provides flexibility in equipment and manpower required to perform the tasks. The carriers are designed so truck drivers need not be at a job location at the time material is removed from storage. Only one forklift and operator are necessary to remove stock from a location and place it on platforms. A driver arrives at the location, backs the carrier under loaded skids, then raises the skids to traveling height and proceeds to the destination. The driver then lowers the skids to ground level and pulls away for another forklift to offload while the carrier operator is in transit to pick up more skids which are loaded and awaiting the driver to transport.

Carriers cost approximately \$65 thousand each and have a service life of ten years. TEAD obtained three sources for purchase, and training is available from the vendors. TEAD has utilized the Straddle Carriers for 18 years and is in the process of procuring its third generation of carriers. Savings have been realized through a reduction of 50% in time to transport equipment to job sites and in the amount of time used by personnel to load and offload ammunition. The number of personnel required to receive and ship ammunition has also been reduced.

Management

Base Realignment and Closure Reuse Efforts

After the 1993 BRAC decision, TEAD found itself facing a massive challenge. The decision took away

its maintenance and general supply missions, leaving the Depot with ammunition operations and the ammunition equipment program. TEAD faced the task of transferring more than 300 buildings, several thousand acres, and thousands of items of personal property to the Local Reuse Authority (LRA). This task had to be accomplished quickly while maintaining the Depot's ability to perform the remaining missions and keep its expense rates competitive — all without comprehensive guidance.

The Depot developed a plan to achieve the majority of the goals within the prescribed time frames. TEAD established communication channels immediately with local, state, and federal agencies as well as project managers at each of the command levels within Department of the Army and the Corps of Engineers. Points of contact were established and regular telephone conferences were conducted. Screening of all real and personal property was conducted and offered to Army, federal, and state agencies before being offered to the LRA. The processes for all environmental issues were started immediately due to the lengthy nature of these actions. These included the Environmental Baseline Survey, Environmental Assessment, Environmental Impact Statement and the Finding of Suitability to Lease/Transfer. A review was conducted on legal jurisdiction. The Depot is currently working on a Master Lease with the LRA.

The Depot's swift and decisive actions enabled it to meet both goals of executing remaining missions and turning over excess property to the LRA. Several tenants are already in place in former Army buildings and employ more than 500 people, with more potential on the horizon.

Commercial Item Approach to Procurement

Section 12.6 of the Federal Acquisition Regulation (FAR) provides streamlined procedures for the evaluation of and solicitation for commercial items, while section 13.6 provides a test program for certain commercial items not exceeding \$5 million. By using these FAR provisions together for commercial item acquisitions, awards can be made in a matter of days. Current experience indicates that commodity costs are consistently below those of similar items acquired prior to use of the streamlined procedures. Contract packages assembled in accordance with the composite procedures appear to be as required by section 12 of the FAR, with synopsis and requirements as required by section 13 of the FAR.

This streamlined approach to commercial product acquisition does rely heavily on an effective market research effort to capture marketplace information specific to the items required. A successful "Commerciality Determination" is critical. A very effective tool available for this purpose is the DOD Internet Market Research Tool, "i-Mart," whose Uniform Resource Locator is: <http://www.acq.osd.mil/ar/cadv.htm>.

After market research has been conducted, the contracting officer must carefully review the organization's requirements based on marketplace knowledge.

These new FAR procedures do not require offerors to submit detailed technical or cost information; rated evaluation of proposals is heavily weighted on past performance history, not solely on pricing. Overall, benefits obtained to date are:

- Enhanced competition
- Better teaming results
- Increased opportunities for small business concerns to compete
- Price reductions
- Reduction in time delays because of paperwork reduction

Condition Code-K Inspections

In October 1996, the Ammunition Operations Directorate decided to use a team approach to process Condition Code-K (CC-K) receipts. Subsequent to 1996, the Directorate had 992 lots in CC-K that required inspection. These lots were more than 45 days past the required processing time for inspection, which caused an unknown safety-in-storage hazard. The holding building of 11,000 square feet was at storage space capacity, and too many people were handling receipt paperwork causing duplication of effort.

By April 1997, the CC-K team achieved a zero backlog status, reduced inspection costs, and improved receipt performance. The morale within the team also improved. The team accomplished this by setting three goals: 1) clear the backlog; 2) save money and time; and 3) have 100% participation of team members.

The CC-K team reached its goals by working smarter. The backlog was cleared by reducing paperwork and transferring ammunition to storage locations. All storage location transfers and condition code changes are done on the receipt document (1348-1) versus Ammunition Transfer Record (ATR).

By not using the ATR, savings of \$170 per lot were realized, equating to more than \$168 thousand in savings in six months. Ammunition is no longer transferred from a receiving tractor trailer, to a storage location, then to an inspection building, and back out to storage. The incoming tractor trailer unloads all ammunition at the CC-K building for inspection. After inspection and classification, the ammunition goes to a storage location. By using this process, the CC-K team is saving both money and time.

In just six months, TEAD's Ammunition Directorate realized many victories by empowering the employees to make cost reduction and time saving changes. It took the support of the Directorate and the commitment by all team members to accomplish the objectives and goals. The CC-K team continues to work toward process improvements by implementing new suggestions. The CC-K team hopes to become self-directed while assisting other teams to reach their goals.

Credit Card Program

The International Merchants Purchase Authorized Card (IMPAC) is a government-wide commercial VISA card used by government organizations to buy supplies and services under the micro purchase limit of \$2,500. Use of this card is intended to simplify purchases at this level by reducing paperwork and approvals, eliminating the need for a purchase order, and ultimately reducing costs. In FY 1996, the Army executed about 1.7 million purchases worth more than \$700 million. According to a January 7, 1997 U.S. Army Audit Agency report, credit card transaction costs were \$92 cheaper per transaction than traditional purchase orders.

TEAD began implementing the IMPAC program in 1993 with 14 transactions, and has steadily increased its use and application. In 1996, the Army established a goal that 80% of all micro purchases be made using the credit card. This goal was raised to 90% in FY 1997. For the first 11 months of FY 1997, TEAD made 8,449 transactions or 96% of all purchases less than \$2,500 by using the IMPAC card. Using the Army estimated savings of \$92 per transaction, more than \$840 thousand per year savings have been realized.

TEAD's contracting directorate instituted several actions to increase credit card usage and reduce costs. The directorate reviewed all purchase requests received from installation organizations, and if they qualified for credit card purchases, returned

the requests to the originator. Continual promotion, education, and training to organizations and credit card holders were also provided. Vendors not accepting the card were encouraged to participate in the program and were notified that it was the preferred method of selling to the Government. Internal procedures were changed to allow controlled purchase of property book (non-expendable) items.

TEAD's existing manual processing system used with credit cards needed to be changed to realize savings per transaction through the Defense Finance and Accounting Service (DFAS), which charges about \$25 per accounting line or credit card transaction. A process action team was formed to address this problem and develop the Tooele Automated Credit Card System. This locally developed system consolidated actions with cost centers and stock accountability, resulting in only one DFAS charge per card holder per month which helped reduce that charge from \$25 to \$11.66. This savings amounts to approximately \$250 thousand per year.

The benefits to full implementation of the IMPAC program extend beyond the cost savings. The end user benefits from added flexibility and convenience, and in many cases receives goods and services faster while vendors receive payment promptly. TEAD exceeded the goals set by higher headquarters, the Army, and DOD by implementing the IMPAC program.

Internet Acquisition Initiatives

A rapid growth has occurred in the number of uses of Government sites on the Internet that provide information or can be utilized to make a DOD contracting office more efficient. These sites include question/answer forums; labor rate determinations; 'how-to' information; regulations and procedures; latest information on acquisition reform; and actual processing of purchasing actions.

TEAD's Contracting Office used many of these sites to increase efficiency in the purchasing area. A process has been developed and implemented to assure that buyers in the contracting office are aware of the capabilities offered by various sites. When a potentially useful site is identified, it is assigned to someone to investigate its utility and report to all office personnel how it can be accessed and what benefit it can provide. A report date is established, and a running log of sites, including report status, is maintained.

Several Internet sites were identified as being of particular value to the contracting office:

- The Commerce Business Daily (CBD) site (<http://cbdnet.access.gpo.gov>) is used for the electronic advertisement and submission of purchase requirements that were traditionally submitted through regular mailing. This submission through CBDnet eliminates the ten-day waiting period for mailing and has reduced annual CBD costs by \$2,800 (from \$18 to \$5 per publication).
- Davis Bacon and Service Contract Act wage determinations as established by the Department of Labor (<http://www.acqnet.sarda.army.mil/>) can be accessed and documented in a matter of minutes compared to the previous practice of submitting wage rate requests to the Department of Labor 90 days in advance of contract award.
- The Army Acquisition web site (<http://www.sarda.army.mil>) provides up-to-date information on acquisition reform initiatives and is a stepping stone to other related acquisition sites.
- The Defense Acquisition Deskbook (<http://129.48.195.226/>) provides a reference library and a question and answer forum.

TEAD's method of analyzing new sites for applicability, and then promulgating the uses throughout the contracting office, are very effective in implementing new acquisition methods. Methods such as these, in conjunction with the use of the Internet, are valuable to the Government and contractors for staying abreast of the many changes involved with acquisition reform.

Mini Stock Record Account

In late 1993, TEAD was notified it would be experiencing a major downsizing effort based on the results of the BRAC actions. TEAD immediately acted to create a process on how to begin downsizing in relation to decreasing the equipment/property stock on records.

After investigating how other installations were proceeding, TEAD determined there was no standard system in use. TEAD proceeded by identifying 12,000 items valued at \$88 million, with the original thought of placing all items on one hand receipt. Realizing the impracticality of this action, TEAD decided a different course of action was required.

TEAD investigated the Installation Equipment Management System, used as the property book system, which had all pertinent information required to inventory and track internal equipment.

Since this system was already in place, the decision was made to do a "mirror image" of the system, and add additional information to locate and maintain a status during the equipment excess process. The creation of the mirror image was called Mini Stock Record Account (MSRA).

The MSRA is designed in three tables. The first table identifies the item by stock number, nomenclature, serial number, bar code, unit cost, and year of manufacture. The second table shows the location of the equipment including the building and bay number; status of the item (whether it is available for city reuse, still in use, and will be available at a later date) being screened for redistribution to another government facility; and the condition of the item. The third table shows where the equipment was eventually transitioned. This system allows tracking by sorting any of the above-mentioned fields, making it user friendly. With downsizing occurring at several other installations and having reviewed the MSRA, the Army Materiel Command obtained the necessary information to implement this plan over the entire command.

Although the plan has already paid benefits through man-hours saved in record keeping, the full savings of the plan has not yet been fully realized.

On-Site Contractor Safety Store

TEAD's Safety Office was instrumental in establishing a service contract to provide employees a single on-installation source for obtaining personal protective equipment and clothing. Prior to this, individual purchase requests were processed through the Contracting Office whenever new safety lenses, boots, or other safety equipment were required by an employee. This was a time consuming process which did not always meet the user's requirements in a timely manner. In 1991, the Safety Office conducted a study to determine how it could more effectively satisfy the safety equipment needs of TEAD organizations, tenants, DCD, and the Chemical Agent Munitions Disposal System (CAMDS). This study projected a first year savings of \$379 thousand per year through hiring a contractor to establish an on-site store dealing with safety clothing and equipment.

In 1993, a one-year contract with four option years was established with Safety West, Inc. to establish a store which would fulfill the requirements of TEAD, tenants, Umatilla Depot Activity, CAMDS, and DCD. This store issues and fits protective footwear, provides prescription safety glasses,

dispenses and fits respirators, and provides various other safety related items either off the shelf or with short delivery times. Significant improvements were obtained in individual fit, quality, delivery times, and cost over the previous process and vendors. In 1996, the contract was negotiated to eliminate store operation costs of \$66 thousand per year previously paid to the contractor. As a result, primary costs were solely for the products bought or ordered. Market analysis further showed that the price for the products remained significantly less than obtaining small or individual quantities through purchase orders.

In January 1997, an analysis was conducted to compare the safety store contract cost with the costs associated with buying the same equipment individually through the recently expanded credit card program. Results showed that the annual cost of equipment bought, buyer travel, and administration expense would be \$65 thousand less than by using the Government credit card program.

The Tooele Safety Office reduced cost and improved customer service through hiring a private contractor to set up a safety clothing and equipment store on post. Protective eye wear is obtained by employees in one week instead of six to eight weeks. Safety boots are better quality, better fitting, and available in a larger selection. A return policy was put into place, and the process for emergency purchases was made more effective. As a result of the effectiveness of this contract, TEAD is looking to renew the contract for the on-site store and pursue possible additional locations in the DCD south area.

Retreats

For the last ten years, TEAD has conducted retreats either on-site or off-site. The Quarterly Retreats (time frame is determined by the Commander) are designed to allow Directors, Division Chiefs, and Special Staff to concentrate on different areas of Depot operations without interruptions. The subjects generally relate to welfare of the Depot and include topics such as Total Quality Management, Cost Buster Initiatives, Strategic Planning Updating, HEARTS Progress, and Activity Based Costing.

These retreats were organized to improve communications both up and down the chain of command, increase mid-management creativity, and set aside time from the normal workload schedule to deal with major issues and discuss the direction of the Depot. Benefits of the program include providing

ing co-workers time to socialize in something other than a work environment, particularly in the off-site retreats, and promotion of a team building concept. These benefits proved to be intangible from the approachability of co-workers in both directions in the chain of command. It has eliminated misinterpretations of information allowing more time to focus on the future of the Depot.

This process is considered to be an excellent management tool that promotes team building and creates a pleasant working environment. This philosophy also solicits employees to submit new ideas and process changes for review that may have been held back prior to the retreat process.

Tooele Initiative Program

Prior to 1995, TEAD was a heavy manufacturing facility where industrial injuries were common and often resulted in workers' compensation awards. Downsizing in 1995 from 3,000 to 500 employees resulted in increased workers' compensation claims. No program was in place to reduce the increasingly high cost of workers' compensation. Injured employees were not offered long-term light duty or alternative jobs if they were no longer able to work in their current positions. TEAD had 65 long-term claimants who had been off work and were drawing full benefits for 10 to 15 years at a cost to TEAD of \$3.3 million per year, adversely affecting labor rates. This was the highest number of long-term claimants in the Industrial Operations Command (IOC). More than 300 claimants were drawing benefits or had claims in process. IOC established a goal of zero long-term claimants and added the incentive of providing one work year for each claimant returned to work.

The Tooele Initiative Program (TIP) was established and designed to quickly and fairly re-employ disabled and injured workers from the long-term workers' compensation rolls. A Compensation Task Team was formed to accomplish this goal. The team included the Depot Commander, directors and supervisors, a compensation specialist, a DOD liaison officer, a physician, a rehabilitation counselor, a compensation investigator, and safety specialists. The team meets regularly and uses an on-site rehabilitation specialist to design light duty jobs. The jobs are specified in functional terms to facilitate review by physicians. Techniques and methods established by the Compensation Team include

supervisor training, use of special equipment for impaired workers such as chairs and tools, flex hours to assist claimants returning to work, video tapes of the work area for reviewing physicians, and counseling for claimants.

Each position is custom designed to the physical requirements of the claimant and carefully specified in functional terms for review by the attending physician, the claimants, their supervisors, and claims examiners. Once approved by the claimant's physician and the claims examiner, a formal job offer is made to the injured worker. If the position is not approved, actions such as referral for a second medical opinion, a functional capacity exam, or modification of the position and job offer can be taken. If an injured worker accepts a job offer, the injury compensation specialist and the worker's supervisor make arrangements to transition the worker back to work. Workers who refuse job offers or elect retirement are eliminated from the compensation rolls. Alternate plans are used by TIP to help with difficult claimants or physicians who are uncooperative.

Figure 2-4 shows the results achieved by the program to date. Long-term claimants have been reduced from 65 to 18 which has produced annual compensation savings of more than \$600 thousand. Lifetime compensation savings to date are estimated at more than \$17 million. The program is fair, effective, and helps keep TEAD's labor rates competitive.

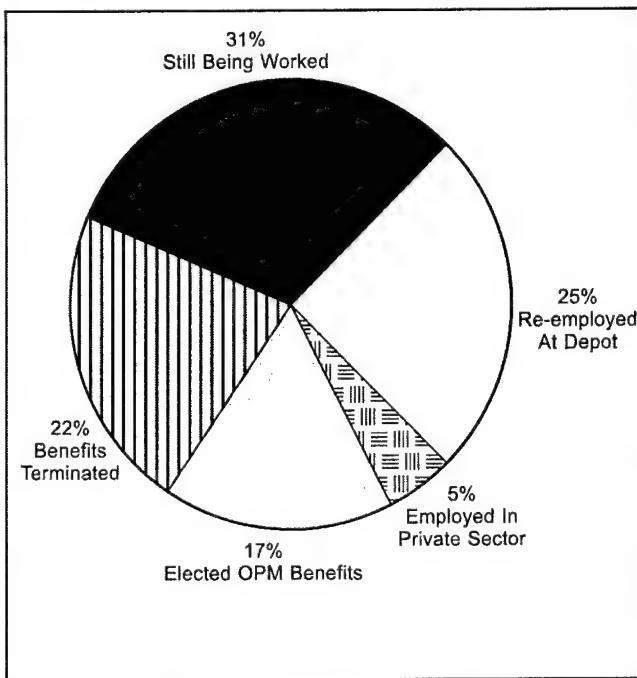


Figure 2-4. Tooele Initiative Program Results

Section 3

Information

Design

Computer Aided Drawing System

TEAD's Ammunition Equipment Directorate utilizes a Hewlett Packard ME10/30, Unix-based CAD system to develop and maintain drawings of equipment. The elimination of hand-drawing with a computer generated drawing system saves time, allows easy modification, and permits sharing with other CAD systems.

Before CAD, approximately 800 drawings per year were hand-drawn, requiring a minimum of 10 to 12 full-time mechanical drafters. The process required drafting tables, drafting aids, scales, tedious lettering, and template work. Additionally, a large work space was required to shuffle and store drawings. Modification of drawings to maintain accuracy was impractical, and drawing quality was extremely operator dependent. Drawings were almost always limited to one size and type and typically out-of-scale.

During 1989 to 1990, the AED installed a Hewlett Packard ME10/30 Unix-based drawing system linked through a Local Area Network to five drawing stations. The CAD system software provides the ability to create and modify two dimensional engineering drawings and gives three-dimensional capability. Solid models are used to produce two dimensional engineering drawings, exploded views, and illustrations as needed. Drawing files are centrally located and easily assessable by all users, allowing any user to share or copy drawings, parts, or details from other drawings to create new drawings faster. The system provides drawing file security by allowing users to give or deny permission to access files they have created. System administration can further control file access permission or control passwords. Backup of drawing and system files are performed nightly, weekly, and monthly to protect against lost or corrupt files. CAD translators allow the sharing of information between AED users and other agencies and groups. CAD files in ME10/30 format can be translated to and from DXF and IGES formats. Drawings can be printed or

plotted in various forms and sizes. CAD drawings are more uniform and precise, and have better quality and appearance than the hand-drawn drawings. The AED has five trained operators with an average of seven years experience.

Since the installation of the CAD system, drawings can be completed faster and more accurately. The average time to finalize has been reduced from 40 hours to 20 hours per drawing. Manpower has been reduced from 10 to 12 draftsmen to four to five CAD operators, while maintaining the same 800 drawings per year workload. Future plans include updating the CAD system hardware and software to allow interfacing with the machine shop CNC machines, buying software capable of simulating stress analysis and other parameters in designs, expanding illustrations and art applications, and improving data management controls and system accounting.

Preparation of Simulated Munitions

While the primary function of TEAD's AED is to develop and support APE, inter-service customers often draw on their expertise to prepare simulated munitions. Some primary needs for these simulated munitions are:

- Cryogenic Demilitarization Testing (both Chemical and Conventional Ammunition)
- Chemical Ammunition Demilitarization Process Equipment Testing
- Set-up or Demonstration of new or modified APE
- Training Aids for Ammunition Training Courses

The simulated ammunition specifications often require actual weighted or balanced duplicates to be developed. Often the actual munitions are obsolete or expensive low-production volume prototypes.

In order to facilitate these requests, AED maintains a vast technical library of ammunition specifications dating back to the 1940s, and a unique inventory of inert and live ammunition components. AED has a history of providing simulated munitions to customers in a timely and cost-effective manner.

Test

Ammunition and Equipment Testing

The AED site has the unique capability to conduct non-destructive testing of high explosive and/or chemical munitions. This capability is unique in that the AED can test and perform measurements in an isolated area with a variety of sophisticated equipment including a deactivation furnace for test purposes. Customers can use the AED test site to perform prototype testing of new products or new equipment.

The AED ammunition equipment testing is available to other non-DOD customers to utilize this sophisticated capability. Potential customers having interest in the test site are other non-DOD agencies such as the National Transportation Safety Board and the Nuclear Regulatory Commission; non-governmental agencies may have interest for testing in hazardous waste applications.

Ammunition X-Ray

TEAD is currently faced with a contract for the Marine Corps which requires X-Ray screening of 40mm linked round (belted) cartridges. The plan requires screening of one million rounds of ammunition per year until FY2003 with the capability to maintain sufficient quantities to facilitate training needs. This screening is necessary to check each round for proper propellant fill and closure cap installation. TEAD is certified to perform X-Ray examinations on 40mm, M430, or M383 cartridges.

In the past, TEAD performed X-Ray imaging on a single round basis, but never with the round still connected in the belt and never to the volume expected of the new contract. The ammunition had to be manually fed into the fixed placement imaging receiver. The new process allows automated feeding of linked cartridges with improved imaging and the added advantage of recording images on video cassette tape. The new system is an APE 2223, Low/High Energy Real Time X-Ray Imaging System, APE 2248, 320kV Mobile Industrial X-Ray System, APE 2263, Integrated Robot and Conveyor System, and APE 2264, Transportable Walk-in X-Ray Enclosure. This equipment is also supplied with a Test Kit which consists of 40mm cartridges with known failing devices belted into the kit to be used as a correlation standard. The system will allow the automated X-Ray imaging of linked belts of M430 or

M383 cartridges on a continuous basis without de-linking individual rounds.

Facilities

Cafeteria Lease to Detroit Diesel

Prior to being included in the BRAC 1993 decision, TEAD had undertaken a major multimillion dollar upgrade program to its manufacturing complex. The newly constructed building complex opened in January 1992 as the CMF. During construction of this facility, the Tooele Post Restaurant Fund borrowed more than \$300 thousand from the Army/Air Force Civilian Welfare Fund to modify and equip a cafeteria to provide food service for the facility. The BRAC 1993 decision eliminated TEAD's maintenance mission and, as a result, the CMF was closed to maintenance operations in October 1994. The undepreciated value of the cafeteria facility (including modifications and equipment) supported with Non-Appropriated Funds (NAF) at the time of closure, was \$395 thousand. TEAD's Post Restaurant Fund was obligated to continue making a \$1,600 per month loan payment to the Civilian Welfare Fund.

As part of the BRAC action, the CMF was transitioned to the city of Tooele and then transferred to Detroit Diesel in July 1996. Since it was modified with NAF funds, the cafeteria area was excluded from the transfer negotiations. It was recognized that the TEAD Post Restaurant Fund owned the cafeteria and its contents, even though it was integral to the CMF. Detroit Diesel did not want to purchase the cafeteria which left TEAD with the following options: reopen the food service to support Detroit Diesel and cover the loan payment; remove the equipment and sell it to commercial vendors; or lease the equipment to a commercial vendor to provide Detroit Diesel food service.

The Army denied the request to reopen the food service in support of Detroit Diesel citing a conflict with commercial vendor availability. Resale of equipment would only recoup about 25% of the original acquisition value, and not cover the amount of the NAF loan. This left the only viable option of a third party lease of the equipment and facility which would enable TEAD to recoup the loan value without loss. In pursuing this option, two open houses were held to advertise the potential lease arrangement which attracted interest from 15 companies. As a result, TEAD's contracting office negotiated a five-year lease to purchase agreement in June 1997,

which included escalating lease payments starting at \$2,500 per month for the first year. This more than covered the \$1,600 loan payment with the additional funds going to support the Civilian Welfare Fund. Detroit Diesel fully supported this approach and provided initial cleaning, maintenance, trash collection, and utilities.

The end result was a successful arrangement for all parties concerned. The Detroit Diesel facility retained an operating cafeteria to support the workforce, a local company was able to set up operation with very little initial investment, and the Tooele Post Restaurant Fund was able to develop a cash flow which more than covered its committed monthly loan payment.

Less than TruckLoad Shipping

TEAD built a new LTL building in 1985. This new building greatly increased efficiency in the process of its Less than TruckLoad shipments. Subsequent to 1985, many problems existed in the old building. The building had no Intrusion Detection (ID) System, a low Net Explosive Weight (NEW), unsatisfactory loading/unloading docks, no facilities for blocking and bracing loads, and no computer capabilities.

The new building has four ID bays and increased NEW. Docks are built onto the building giving the loading crew easy access to rail cars, vans, dromedaries, and milvans. One bay is dedicated as a woodshop where the crew can build boxes and crates. LTL has full on-line computer capability which provides valuable information such as the Joint Hazard Classification System. Twelve temporary storage bays also exist in the building.

TEAD's new LTL building saved both money and time with less intra-depot movement of ammunition being required; commercial carriers have immediate service which eliminated demurrage charges; and boxes and crates can be manufactured on site.

Reuse of Telephone Switch

The Depot telephone system network, installed in 1987, was a Telephone Exchange system which had been supported/maintained by a contractor who had since gone out of business. Gradual deterioration of the system had progressed to the point of daily failures, particularly in the main switch network terminal array. The situation was aggravated by difficulties in obtaining replacement parts, while

replacement by a complete new system was not feasible because of the high cost (\$1.5 million).

The Depot reviewed the available listing of other Army facilities having similar equipment available as used items, and was able to locate a used replacement switch array (Northern Telecom, SL-1 unit).

The cost for this telephone system acquisition and installation was \$480 thousand, funded through the Army Life Cycle Rehabilitation Program, with a resultant saving over a new procurement of more than \$1 million.

Logistics

CONUS Freight Management System

Prior to the implementation of CONUS (Continental United States) Freight Management (CFM) System, transportation personnel submitted requests for rates and routes for commercial carriers to the Military Transportation Management Command (MTMC) regional office. Often, there were long delays in receiving this information from MTMC, and follow-up actions were often needed. Once the information was received, the data was entered into the Standard Depot System (SDS) and the system would generate the Government Bill of Lading (GBL). The commercial carriers were paid once the GBL was signed by the consignee, and the form was turned in to DFAS. DFAS would then issue a check to the carrier.

MTMC designed and distributed CFM to Army installations in 1995. TEAD implemented CFM and is using the system to its fullest. CFM provides an Electronic Data Interface between the installation, MTMC, the commercial carrier, and DFAS. The requirement to ship an item is loaded into CFM by the installation. CFM transmits the request to MTMC, gives the installation the rates and routes for the lowest priced carrier, and provides the carrier's acceptance for the shipment. This process may take as little as 45 minutes compared to hours and even days before CFM. CFM then prints out the GBL for the installation. CFM also makes it possible to electronically create and answer Transportation Discrepancy Reports, and is capable of creating a variety of reports for management purposes as well as for data calls. CFM provides a review of carrier performance which the Transportation Officer may use for future use.

TEAD implemented CFM as directed, and is using all of the facets of the program. TEAD transpor-

tation personnel are fully satisfied with the system, and once a bridge is developed between SDS and CFM, the full benefits of the system will be realized.

Direct Sale Authority of Recyclable Material

TEAD's recycling program consisted of recycling through the Defense Reutilization and Marketing Services (DRMS). This process proved to be paper intensive and time consuming. Long-term storage of recyclable products was necessary due to the DRMS process. Once the material was sold, the contractor's payment was to DRMS at Hill Air Force Base, Utah or Battle Creek, Michigan. DRMS would then notify DFAS in Columbus, Ohio. DFAS in Columbus would prepare a check or Standard Form 1080 billing to TEAD or DFAS in Rock Island, Illinois. If the monies were sent to DFAS in Rock Island, DFAS in Rock Island would issue a check to the Installation's Community and Family Activities. The DRMS sale process averaged nine to twelve months and proved challenging to track. Monies within the DRMS process had the potential to become misplaced or lost. A DLA letter, dated September 20, 1996, with the subject Implementation of Changes to the Recycle, Recover, and Reuse Program and DRMS Scrap Program, authorized the direct sales of scrap/recyclable materials at installations.

Typical direct sales at TEAD consist of railroad ties, scrap wood, paper, cardboard, and other miscellaneous items. The sales vary from individuals to contractors. A number is assigned to each sale which is logged into a user-friendly Lotus 1-2-3 spreadsheet database. Files with corresponding numbers are kept for every sale. From February 20, 1997 to August 28, 1997, 80 sales totaling \$118,825 have been recorded. Under the direct sale authority, receipt of monies is immediate or within 30 days. The monies received become part of the Installation's community and family activities fund.

Long-term storage, labor intensive tracking throughout various agencies, and loss of monies due to misplacement were eliminated. The direct sale authority at TEAD decreased the sale processing time from months to days.

Federal Express Powership

Federal Express has a computer system called Powership which is available to any commercial company or government facility that uses the ser-

vice. Federal Express provides a computer, installation, software, and printer free of charge. Powership benefits both Federal Express and the user by saving both money and time.

Before Powership was implemented, all non-hazardous and hazardous Air Bills were completed manually on a typewriter with a Defense Department Form 1348-1. Addresses were manually typed on a label and placed on the package to be shipped.

Powership has nine functions in an easy to follow format and covers processes such as shipping, receiving, tracking, label preparation, and closing out the business day. It can process both domestic and international shipments to include Hawaii and Alaska. Powership prepares labels by entering a receipt code and completing a few information fields. The system tracks shipments and is capable of providing shipment status by use of the Federal Express worldwide satellite computer system. The database function stores an electronic address book of the most frequent customers. It will also store cost center codes enabling documentation of shipping costs for management reports. Reports can be viewed or printed for any day within the last ten days. Federal Express picks up shipments of both hazardous and non-hazardous materials daily.

TEAD benefitted many ways by using the Powership Program — a reduction in paperwork has occurred; a centralized pick up point and time were established; and a yearly savings of \$10,500 was realized.

Inert Storage

TEAD was experiencing the loss of premium storage space for explosive items due to the need to stow inert material in igloos designed for the storage of explosives. As the Army downsized, ammunition depots were closed, and thousands of tons of ammunition once stored overseas were returned to CONUS depots. Premium ammunition storage space became even more valuable. Due to BRAC closures, TEAD lost its General Supply mission. Management actively pursued and prevailed in gaining control of several General Purpose warehouses, instead of these warehouses being turned over to the Local Reuse Authority. Once this was achieved, the inert material was relocated to these warehouses.

TEAD made full use of the empty warehouses, and vacated premium storage space in the igloos by affording the IOC more capability for the storage of explosives. The warehouses afforded 530,000 square

feet of space for inert material which provided TEAD with 350,000 square feet of igloo storage space for explosives.

This was an excellent management initiative which improved TEAD's storage posture, thus making the Depot more valuable to the Army.

Intel 16 Shipping Database

Prior to 1991, records keeping in the Transportation operation was manually performed. A manual register was maintained for outbound shipments. All other data on the SDS was maintained for 90 days and then archived to magnetic tape. The numerous data calls which the depots were subjected to during Desert Storm highlighted the shortcomings of the existing system. The manual register often had incomplete entries, and once the data on SDS was archived, it was not readily available. Much time was spent going through files and manually tabulating data.

A database was created in 1991 on the Intel 16 mainframe. This database contains the Shipment Planning Worksheet number, type of commodity, the Transportation Control Number, the Government Bill of Lading, weight, quantity, cube, and the carrier. This data is keyed into the system by the Freight Rate Specialist. This causes some increased work up front; however, this is offset by the savings in research time. Information is readily available in whatever format is required, and can be accessed from off-post in cases of emergency when information is needed immediately.

The savings generated by this practice are largely intangible, but management now has a tool which quickly provides information that traditionally may have taken several employees up to a week to gather. The Depot personnel took what resources were available to them and created a simple, but effective, management tool.

Social Services Joint Cooperation Agreement

TEAD's Community and Family Activity Directorate established an Army Community Services (ACS) Office in 1985. The ACS office implemented a program which serves as a vehicle for employees and family members to receive services and resources necessary to maintain a high quality of life at work and at home. This includes more than 7,000 military and retired military personnel within an

80-mile radius, and more than 1,000 civilians at TEAD, DCD, and Tooele Chemical Demilitarization Facility. The ACS staff has dedicated itself to work with the local community to coordinate resources and services of all agencies to provide a healthier, safer environment for its constituents and their family members.

The ACS, which is funded through the Army Materiel Command, provides services in the areas of relocation, information and referral, family advocacy, and consumer affairs. The ACS established agreements with local community agencies and with agencies throughout the Wasatch Front to serve employees living up to 80 miles from their work site. Community support was enlisted to aid families of 170 military and civilian employees deployed for Desert Shield/Desert Storm. Community liaison continued to help smooth the transition of 3,500 employees affected by the 1993 BRAC decision to move TEAD's maintenance mission.

Following the BRAC downsizing and consolidation, the Drug and Alcohol Program was added to the ACS responsibilities. This included employee assistance programs, installation biochemical test coordination and civilian personnel coordination. The cooperative agreements established with community organizations were essential to accomplish this expanded mission in a time of downsizing and without significantly increasing available resources. This community partnership included local schools, the American Red Cross, the Together With Youth Program, family services organizations, mental health services, and law enforcement. Significant programs include providing school facilities for the Tooele Valley High School educational programs, and sponsorship of the stay in school program. Resources are shared with law enforcement agencies and a memorandum of agreement was signed with Human Services and Mental Health. The combined services of TEAD's ACS and the local agencies are essential to maintain effectiveness in a period of downsizing in Government and local community resources.

Management

Base Realignment and Closure Clean Up Team, Fort Wingate Depot Activity

The President's Plan established a Base Clean Up Team (BCT) for DOD installations slated for closure or realignment where property was available for

community transfer. A typical BCT is comprised of one representative from DOD, one representative from the state, and one representative from the EPA. The plan empowers the team with the authority, responsibility, and accountability for all Environmental Cleanup Programs at these installations, emphasizing those actions which are necessary to facilitate reuse and redevelopment. In 1995, a BCT was formed at Fort Wingate Depot Activity (FWDA), New Mexico.

The BCT is responsible for 45 environmental sites. Of the 45 sites, four have confirmed contamination. The early stages of the BCT have seen accelerated progress. The confirmed contaminated sites are currently in the Remedial Investigation/Feasibility Study (RI/FS) Phase. Following the RI/FS is the Remedial Design Phase, followed by the Remedial Action Phase.

The BCT conducts quarterly meetings chaired by the BRAC Environmental Coordinator and a DOD representative. The benefits of the BCT include better communication among all parties, elimination of duplication of effort, best utilization of limited resources, and proper exchange of information with a reduction in document review time. The forum of the meetings consists of project reviews followed by team decision making.

As the progress accelerated, challenges were encountered due to personnel changes by the State. The State of Utah's changing participation resulted in decelerated decision making, therefore impacting the schedule of restoring and transferring property. Meetings are currently underway with Army Materiel Command and the State of Utah to resolve the participation issues at hand.

The FWDA BCT has seen successes met with challenges. Implementation of the President's Plan resulted in an accelerated schedule toward reuse and redevelopment of FWDA. The BCT efforts are underway for complete transfer of property to the community.

Cost Busting Initiatives

During November 1996, TEAD held a retreat where the attendees brain-stormed a series of cost reduction (termed cost busting) initiatives. A total of 61 ideas, having potential for significant cost savings, were identified at that time.

The items were carefully analyzed during the next retreat held in January 1997. As a result, several items were closed out, while others were combined to avoid duplication. The end result was a

total of 36 initiatives for action. Each Depot directorate was then assigned responsibility for initiation, monitoring, and progress reporting on each of their respective initiatives.

As of July 1997, a total cost savings of \$2,137,026.26 had been realized. Significant savings were attained in the areas of Equipment Utilization, Requisitioning of Equipment and Supplies, and Deferring Equipment Depreciation. Examples of effective cost savings include:

- Equipment Utilization: \$110,512
- Equipment/Supplies Requisition: \$236,343
- Excess Facilities: \$50,000
- Equipment Depreciation Deferral: \$838,582
- Project Scrub-FE (items canceled by facilities engineering): \$708,500

Customer Feedback

Prior to FY1992, the Defense Nontactical Generator and Rail Equipment Center (DGRC) mission was assigned to the Aviation & Troop Support Command and was perceived to have a reputation of poor quality and service. All negative comments and rumors were forwarded to Headquarters without substantiated paperwork to support the allegations. Much of this undeserved ridicule was based on the nature of the work, poor structuring of the assigned duties, and to a degree, lack of ownership of the function. In the past, once maintenance operations were performed at an installation, no additional work was scheduled to be performed until the next audit. This left the workforce with nothing to fill unoccupied time other than idle away the hours. This was often interpreted as not having the ability to do quality work, thus the reputation of inferior work and work ethics. After the transfer of these duties to DGRC, steps were taken to not only declare ownership, but to rectify the reputation of the organization and provide greater service capabilities without jeopardizing quality workmanship.

DGRC's solution to alleviate the problem was to obtain a voluntary written evaluation of the current service upon completion of the maintenance audit by each installation. Secondly, DGRC focused on areas of service where the quality of the service may have been below standard. Finally, DGRC had to immediately correct problems where identified and reward employees who showed exceptional service and customer satisfaction.

By informing customers of additional services it could provide, DGRC also took steps to provide

additional tasks to the workforce during periods of time when maintenance audits were not scheduled. DGRC updated its service to include advance notices to the installations concerning the team's arrival, identified the type of support equipment needed to complete the assigned task, and developed a checklist of the maintenance to be performed. These steps eliminate downtime once the team arrives on the site.

All the customer surveys that have been returned are in the "above average" to "excellent" category; however, as with many surveys, some have not been returned or have not yet been received. This should not be misconstrued as poor quality workmanship.

The customer surveys are a critical analytical correction tool for eliminating a reputation of poor quality work. The surveys also identify areas of improvement, which will enable the level of satisfaction with the services to improve.

Hazardous Materials Management Program

In an effort to record hazardous materials used by the Ammunition Operations Directorate, TEAD developed a management program. Two years ago, materials such as paint and solvents, being used by personnel had no centralized control. An unlimited number of people could request hazardous materials. No control over quantities on hand existed, and shelf life was expiring on items that were still being used. No record was being kept on exposure to workers. Therefore, the Hazardous Materials Management Program was developed. The program has four goals: 1) comply with toxic substance regulations; 2) prevent pollution; 3) reduce health risk of personnel by documenting exposure; and 4) control quantities on hand to assure a cost savings. These goals are accomplished by working with the Safety Office, Environmental Management Division, and the Installation Medical Officer.

The Ammunition Tool Room has inventoried all hazardous materials in the Directorate and cataloged them into a database. This database is used to receive and issue hazardous materials for Ammunition Operations. If a hazardous material is not in the database, it must be requested by a Supervisor on TEAD's local form SDSTE Form 3871-1 CHEMICAL HAZARD PERMIT TO ORDER. The form then goes to the Safety office which obtains the required MSDS information and approves the order. The Safety Office may also reject any chemical or suggest a possible substitute product. Upon approval, the

Tool Room can order the hazardous material and input the appropriate information into the database.

When operations are in progress, only the hazardous material that is needed for one day is issued. At the end of the operations, all remaining hazardous materials are removed from the facility and returned to the Tool Room. This material is then sorted and turned in to general supply for reuse.

TEAD has reaped many benefits from documenting the Hazardous Materials Management Program in a database. These benefits include: more information is available for planning work requirements, increased control over inventory, reduced environmental impact, and lower health risks to personnel.

Hazardous Waste Tracking

TEAD is a permitted hazardous waste storage facility. To comply with the State's permit requirements, records must be kept and biannual reports submitted. Previous to the Automated Hazardous Waste Tracking System, the tracking system consisted of handwritten operation records. These records were developed when the drums reached one of the 24 satellite storage facilities or one of the three 90-day storage facilities. The handwritten operating records were tracked in a DOS-based, in-house developed database. Unfortunately, the DOS-based program proved to be challenging to work with, and required the program developer to compile the biannual reports. The presence of the program developer was critical to the success of the reporting. A user-friendly program was needed to enable a number of people to query data, thereby reducing the potential of receiving notice of violations (NOVs) from the State.

In the summer of 1997, TEAD began implementing an Automated Hazardous Waste Tracking System. An average of 300 barrels per year are assigned container numbers and bar codes at the point of generation. This information is tracked with an in-house developed Microsoft Access database. A database dump from the previous DOS-based database to the new database, along with the programming was conducted by an in-house hazardous waste specialist with limited programming experience. The new user-friendly database automates all the reporting and enables immediate drum status access. The biannual report development time was reduced by approximately 50%.

By utilizing a user-friendly software program along with automation, TEAD is able to obtain real-time barrel status access from the point of genera-

tion to turn-in. Biannual reports can be compiled by a number of individuals, with a 50% reduction in review and compilation time. The efficiency and user friendliness of TEAD's Automated Hazardous Waste Tracking System enables the record keeping requirements to be easily met, therefore reducing the potential of receiving NOVs.

Joint Use of Morale Welfare and Recreation Facilities

TEAD has many recreational facilities that are enjoyed by numerous authorized personnel. Under the provisions of the Army's Morale, Welfare, and Recreation (MWR) Regulation, the Commander has the authorization to approve limited use of the MWR facilities by the community. On February 20, 1996, the Commander authorized a joint use agreement with the Tooele community. Previous to the agreement, only TEAD's employees and their guests could enjoy the use of the facilities.

In order to protect the Tooele business community from unfair competition, the Tooele Chamber of Commerce and the City Council were involved in determining which facilities would be included in the agreement. The existing agreement applies to the following MWR facilities: softball fields, riding stables, basketball court, swimming pool, travel camp, archery range, rifle range, trap and skeet range, gazebo park, MWR sponsored events, and bowling center. Groups or individuals utilizing the facilities are required to sign a Release and Hold Harmless Agreement, and are subjected to normal fees and charges. The revenues generated assist in offsetting the maintenance costs for the MWR program.

Without promoting unfair business competition, TEAD's Joint Use Agreement for MWR facilities has proven beneficial to the community and the Depot's MWR program.

Matrix Cost Estimating

The AED follows a formalized proposal process consisting of estimating man-hours, material cost, contract cost, and travel required to provide needed equipment and technical support requested by its inter-service customers.

The AED specialty is designing, prototyping, producing, and fielding APE for production and demilitarization of chemical and conventional ammunition. The AED anticipates the needs of its customers through an awareness of ammunition technology,

manufacturing processes, inventories, field conditions, and constant contact with its customers and potential customers. When AED or its customers indicate a requirement that cannot be met with existing APE, the AED works closely with the IOC and APE manager to quickly develop, budget, and fund a project to provide the needed equipment and technical support in a timely manner.

Most proposals are for APE and cover concept and engineering studies, ammunition testing and prototype development, and production of APE. Costing elements are presented in estimated man-hours required to perform the work, raw material for machining, contracts for major components, and travel for fielding the equipment. Labor costing is determined for each functional element contributing to the work to be performed. Estimates are based on experience, past history, and current costing conditions. A justification and impact statement is provided with each project proposal. Small projects less than \$25 thousand are completed within a year funding cycle, while larger projects require carry-over money to extend into a second year.

A key element of the proposal process is to work closely with the IOC and its customers to budget for anticipated needs, thus avoiding lengthy and drawn out funding procedures. This approach makes equipment available when needed instead of delaying the design and fabrication until the requirement is immediate.

Maximizing Demilitarization Capability

Over the past several years, TEAD suffered severe restrictions on its demilitarization capability. These restrictions came about as a result of the Chemical Demilitarization Program at DCD, state-imposed environmental constraints, and noise complaints from neighbors. Due to these actions, TEAD lost the full capability at DCD which gave them the ability to utilize 26 open detonation pits with a 3,000 pound NEW per pit, and seven burn pans with a limit of 1,000 pounds per pan. This alone constituted a loss of 85,000 pounds of NEW demilitarization capability per day. In addition, the NEW limits for the demolition ground pits were reduced at TEAD from 1,500 pounds to 750 pounds per pit, and restricted items to less than five inches in diameter to reduce noise complaints from neighbors. On top of these constraints, TEAD is also limited by the State's environmental agency to no more than 20,000 pounds per hour NEW for open detonation, and 12,000 pounds per hour for open burning.

These constraints have driven TEAD to focus more of its demilitarization efforts on the APE 1236 Deactivation Furnace, the Contaminated Waste Processor, teaming with private industry, and improving its R3 capability. TEAD is looking to the future and utilizing its capabilities to the fullest.

Meeting Workload Requirements with Minimum Staffing Levels

A fire service is a vital and necessary function on a storage installation such as TEAD and a chemical location such as DCD. Although fire service is considered overhead, these locations could not rely on a volunteer or community fire station. According to Manpower Staffing Standards System and Department of Defense Instruction 6055.6 which reflect minimum staffing levels for the fire service, TEAD should have 33 employees. Instead, TEAD has maintained a personnel level of 25 since March 1993. Even though it is below minimum staffing levels, TEAD is able to maintain the required level of protection. The Division provides services to both TEAD and DCD as well as support to surrounding communities. The Division responds to all emergencies including fire, medical, hazardous materials incidents, chemical, and ammunition incidents. Personnel also provide many fire prevention functions that include inspecting buildings, training in fire safety, use of fire extinguishers, and assisting with building evacuation drills.

TEAD's Fire and Emergency Services Division also has the primary Staff Duty Officer function during regular non-duty days and after hours on the Depot which saves the Depot \$250 thousand yearly.

Partnership with Private Industry

TEAD conducted ongoing discussions with private industry concerning a number of partnership concepts. The enormity of this task has been a learning experience for both management and the working sector who feel threatened by the loss of workload through the Army Materiel Command's (AMC's) goal to provide 50% of the demilitarization work to the private sector. This fear factor has only heightened the difficulty of learning the elements of developing a partnership with private industry. TEAD's goals were to increase workload, give visibility to the program, and create a template for obtaining future work. Few guidelines existed in the past for seeking new avenues to gain additional workload, complicated by the lack of confidence with

the capabilities of the private sector to be able to meet specific requirements sent down by command.

TEAD identified a need for improvement by analyzing the causes of the reduction of workload and recognized the lack of the R3 capability. To partner with private industry, all areas were reviewed to determine what tasks TEAD was capable of doing that could not feasibly be done by the private sector. By doing so, TEAD would be able to protect the workforce and gain visibility with AMC. This process also created a competitive environment with private industry which stimulated lower costs to the military.

The establishment of this new process opened discussions with private industry and generated a new philosophy on how TEAD can be a partner, not a competitor, by building a relationship based on trust. This allows a more focused outlook on the development of the R3 program. As an example of this partnership, TEAD recently consolidated a partnership with Thiokol Corporation to recycle propellant generated from five inch rocket motors. TEAD will disassemble the rocket motors, and Thiokol Corporation will recycle the propellant for industrial use. This partnership has resulted in an IOC-funded \$3.5 million contract for TEAD. TEAD is also working on a similar propellant recycling effort with EASE Corporation.

Patrol Acreage vs. Staffing Levels

In order to provide the most efficient security for the least cost, TEAD's Law Enforcement and Security Division initiated rightsizing. Prior to the rightsizing, the patrol acreage at the Installation was 25,131 acres. The facility was considered a closed Installation with two outer main entrance gates. Encompassed within the closed Installation were 260 buildings, 259 BRAC buildings, 902 earth covered magazines (97 of which are category I & II), 12 above-ground magazines, six general purpose warehouses, and 406 revetments. The staffing levels of eight administrative and 40 security police officers were responsible for the Installation. Rightsizing would enable the Installation to keep the security labor rates competitive with that of private contractors.

The rightsizing initiative forced the review of all current security processes. These processes were then compared to the basic Army Regulations security requirements. The processes that exceeded the basic Army Regulations were eliminated (i.e., changing the closed Installation policy to an open Instal-

lation policy, thus eliminating the two outer security gates).

Reviewing the processes enabled the consolidation of related security duties. Currently, four administrative staff and 26 security officers are responsible for the same acreage, buildings, magazines, warehouses, and revetments. In addition to consolidation, utilizing a training module system that trains the security officers during their on-shift duty will provide an estimated \$203 thousand in savings over the next three years.

By reviewing the current security processes and comparing them to the basic Army Regulations, TEAD was able to realize cost savings by eliminating processes that exceeded the basic regulations. The review also revealed opportunities to consolidate duties. A total of 18 security positions were eliminated and a \$203 thousand savings was realized by implementing the training module system. The rightsizing initiative was essential in developing a basic, but effective, competitive security program at TEAD.

Project Management Improvements

TEAD's AED is exploring the concept of establishing a Project Review Board to provide technical oversight of a project throughout the development cycle. The AED feels that the oversight provided by the Board will result in the best possible technical solution being implemented to satisfy customers' requirements.

The AED's current approach to project management begins with a team being assigned the task of completing the project. This team consists of engineers, technicians, equipment specialists, draftsmen, material buyers, and production shop personnel. A project manager, usually an engineer, is assigned to oversee all aspects of the project from conception and design phase to installation and field support. The project manager must ensure that the customer's requirements are met, and that safety and environmental compliance issues are satisfied. As a project progresses through the development cycle, other team members may assume primary responsibility in completing tasks that are directly related to their normal duties. However, the outcome of the project development process may be heavily influenced by the project manager's technical background and past experience.

As a means of obtaining the best technical solution possible, the AED is in the process of establishing a Project Review Board for each project. This

Project Review Board would consist of one member from AED's upper management, and two or three of AED's more experienced engineers whose backgrounds are related to the task at hand. The Board would be a source of technical guidance and expertise readily available to the project team. It would be the Project Review Board's responsibility to interface with the project manager during the concept and design phase of the development cycle to ensure that the best possible technical solution was being implemented. The Board would also be responsible for ensuring that the project stayed on schedule, and that all applicable steps in AED's project development cycle were completed.

Project Matrix Management

As a result of downsizing and mission changes, the AED implemented Project Matrix Management as a way of conducting business for current and future workloads. Previously, the Directorate had seven divisions with 90 employees. Its mission was to design, test, and field ammunition production equipment. The current focus of the Directorate is on demilitarization equipment. Since the change in mission, the Directorate consolidated into four divisions with 70 employees.

Division chiefs now assign project managers to all incoming work. Project managers then select team members where possible. The key point is that matrix management is project-driven, not organizationally-driven. The benefits are both near-term and long-term.

Near-term benefits include increased cross training of Directorate personnel, increased flexibility in assigning Directorate personnel, and a significant increase in synergy between employees. A long-term benefit is increased empowerment of employees. This strengthens accountability to both the project and to fellow employees. Additionally, future rewards will be based on group (project) performance.

Project Proposals

The AED uses a combination spreadsheet/matrix to develop its cost estimates for project bids. Prior to using the Matrix Cost Estimating method, the AED would perform all calculations to prepare cost estimates submitted with project bid packages. The manually prepared estimates did not provide sufficient information to justify AED's bids on large-scale contract items.

In 1995, the AED developed a Matrix Cost Estimating method using a commercial-off-the-shelf spreadsheet software package. This method allows AED to define each task that must be completed to comply with the customer's request with the associated cost of completing the task. Details such as the type of skill and number of man-hours required, labor and material costs, and any associated travel or contractor costs are itemized for each task. This information is then summarized in a spreadsheet that is included in the bid package submitted to the customer making the request for AED's services.

Because calculations are done automatically, the software spreadsheet package provides the AED the capability to prepare a cost estimate in two days versus the one week preparation time required when calculations were done by hand. The various fields in the spreadsheet can be modified to fit each customer's requirements. Once the cost estimate is complete, this information is used to develop scheduling baselines and other project management tools, such as pert charts.

Using the Matrix Cost Estimating method provides the AED with a means of handling requests for bids and customer inquiries concerning pricing in a more timely and efficient manner.

Recurring Contract Requirements

TEAD's contracting office established a procedure for notifying requisitioning organizations/users of the need for recurring purchase requirements. A 90-day advance notice is provided in the form of a memorandum explaining that referenced contracts and purchase orders are expiring, and requesting action to renew if desired within a 30-day period. The notification is automated, and provides the following benefits:

- Automated early warning of expiring contracts
- Reduction/elimination of unauthorized procurement
- Assurance of continuity of services and/or supply deliveries

E-mail (cc:mail) capabilities are currently being implemented. Once this is accomplished, consideration to provide these notifications by using electronic mail will be reviewed.

Reduction In Depreciation Costs

TEAD realized that depreciation costs for installation operating equipment and property book items

were extremely high, contributing to inflated labor rates. This induced TEAD to seek improvement in the reduction of depreciation costs by having the Equipment/Property Division furnish a depreciation listing to all hand receipt holders. The receipt holders were to then make a determination on the retention requirements based on current and scheduled workloads, versus the nice to-have-but-seldom-used concept. The equipment no longer needed would then be used for transfer, turn-in, or adjustment.

The new process established by TEAD will continue to monitor and challenge equipment requests and new purchases for validity. Additionally, all equipment users will be required to justify underutilized equipment on a yearly basis to the Depot Commander in accordance with TEAD's Equipment Utilization Management Plan.

TEAD saved more than \$800 thousand in yearly depreciation costs associated with this equipment. An additional reduction in Depot labor rates of approximately \$2.67 per man-hour was realized by transferring equipment to other installations or tenant activities (activities that were originally the users of the equipment), turning in items not utilized, and adjusting items that had not been entered into the Defense Property Accountability System. This is a valuable cost reduction innovation plan to reduce and maintain lower overhead costs.

Specialty Skills

The AED maintains specialty skills in the design, development, testing, fielding, and technical documentation of equipment for demilitarization and renovation of conventional ammunition.

The AED trains a variety of Directorate personnel in the properties, uses, and effects of explosives and munitions. Personnel are trained in both explosive safety and ammunition handling. When a demilitarization application arises other than open detonation or open burning, the AED will either retrofit or design and manufacture equipment to perform the operation. The AED has the expertise in a variety of skills to develop a workable solution for the application.

The AED also provides the initial technical documentation to satisfy the Army safety standards. Because AED personnel have the appropriate safety and environmental training, all Occupational Safety and Health Administration and EPA requirements are met for renovated or new demilitarization equipment.

Strategic Planning

TEAD began developing and implementing a formal strategic planning process in April 1997. Prior to this time, no strategic plan existed for the Depot and no real strategic vision or clear mission statement was in effect. The leadership focused on making daily operational decisions with low emphasis on future direction and long-term planning. Customer feedback was negligible and typically involved only problem incidents highlighted by occasional discrepancy reports on individual ammunition shipments. Many tracking measures were in place and reported; however, a high level of uncertainty existed as to how useful and important individual measures were or how significant their contributions were to the success of Depot operations.

The strategic planning process was spurred by the Government Performance and Results Act of 1993. Depot managers recognized that strategic planning would help determine the Depot's niche within the IOC, protect against further reductions in workload and workforce, identify the core capabilities of the Depot, and provide the Facility with more control over its own destiny.

The new planning process is based on the Strategic Planning Engine (SPE) developed by Michael G. Dolence and Associates. SPE is a 10-step cyclic method that helps complex organizations make strategic decisions at all levels. The methodology is simple and scalable. The heart of SPE links strategic decision making with organizational key performance indicators. It employs Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis, customer identification, and internal and external environmental assessments. The 10 steps of the SPE are:

- Step 1: Develop Key Performance Indicators (KPIs)
- Step 2: Perform an external environmental assessment
- Step 3: Perform an internal environmental assessment
- Step 4: Perform a SWOT analysis
- Step 5: Conduct brainstorming
- Step 6: Evaluate the potential impact of each idea on each SWOT
- Step 7: Formulate strategies, missions, goals, and objectives

- Step 8: Conduct a cross-impact analysis to determine the impact of the proposed strategies, goals, and objectives on the organization's ability to achieve its KPIs
- Step 9: Finalize and implement strategies, goals, and objectives
- Step 10: Evaluate actual impact of strategies, goals, and objectives on organizational KPIs

The new process is still being implemented and refined. Initial benefits include the identification of core competencies, determination of meaningful performance measures, and identification of potential new business opportunities. The process of developing a structural approach to strategic planning has helped Depot personnel learn that diversified viewpoints produce better ideas and understanding, and that both internal and external customers are important to accomplish TEAD's mission. The strategic planning remains an ongoing process.

Teaming

TEAD's Directorate of Ammunition Operations was a traditional hierarchical organization composed of seven divisions split along functional lines. This organization depended significantly on step-by-step procedures with little actual process improvement knowledge or discussion crossing divisional lines. In June 1997, a decision was made to develop a team-oriented approach to accomplish the Directorate's mission. This approach was implemented on a provisional basis for a 90-day period beginning June 30, 1997 to work out problems and solidify working relationships. The structure is scheduled to become permanent in October 1997.

The first step used in transitioning to the team approach was to train all members of the Directorate in team concepts. This was accomplished in a three-week period ending June 26, 1997. The original seven divisions were split into three broad areas composed of 10 teams ranging in size from nine to 21 people. The primary areas included shipping/receiving, stockpile management, and inspection and demilitarization.

The team approach provided for a more cross-functional organization than the previous structure aligned by stove-piped functions. For example, Quality Assurance Specialists for Ammunition Surveillance were interspersed in six of the 10 teams. The

team approach allows those with the most intimate process knowledge to be an integral part in suggesting and implementing improvement ideas.

Worker's Compensation Claims Review Board

TEAD has a Federal Employees' Compensation Act Claims Review Board that meets weekly. Members include the Depot Commander and directors, safety and occupational health specialists, Depot physician, occupational health nurse, claims administrator, claims investigator, and appropriate supervisors of injured workers. The Board was established in 1987 to deal with critical issues such as workplace accidents and injuries, high dollar costs of claims, impact of downsizing measures, and new job hazards. The Review Board brought together all of the officials involved with these issues and integrated risk management into Depot operations.

The Board meets weekly and takes a proactive approach to understanding what occurred and how to prevent similar accidents in the future. The Board discusses specific causes of accidents, preventive and corrective actions, and accuracy of record keeping as well as analyzing operations. Injuries

are reviewed, and workers are evaluated for the potential to return to work or light duty. These meetings and reviews also provide compensation investigators with the background to pursue an investigation if necessary.

The Board instituted many initiatives to prevent and reduce injuries such as training, fitness programs, safety awareness, and team building. Table 3-1 shows how effective this approach has been in reducing lost time injuries and lost work days since 1992. The key to success has been strong commitment and support from top management.

Table 3-1. Historical Statistics

Year	Lost Time Injuries	Lost Work Days
1992	142	1656
1993	99	1409
1994	71	626
1995	47	685
1996	15	355
1997	13	241

Appendix A

Table of Acronyms

Acronym	Definition
ACS	Army Community Services
AED	Ammunition Equipment Directorate
AMC	Army Materiel Command
APE	Ammunition Peculiar Equipment
ATR	Ammunition Transfer Record
BCT	Base Realignment and Closure Clean Up Team
BRAC	Base Realignment and Closure
CAD	Computer Aided Drawing
CAMDS	Chemical Agent Munitions Disposal System
CBD	Commerce Business Daily
CC-K	Condition Code-K
CFM	CONUS Freight Management
CMF	Consolidated Maintenance Facility
CNC	Computer Numerical Control
CONUS	Continental United States
DCD	Deseret Chemical Depot
DFAS	Defense Finance and Accounting Service
DGRC	Defense Nontactical Generator and Rail Equipment Center
DLA	Defense Logistics Agency
DOD	Department of Defense
DRMS	Defense Reutilization and Marketing Services
EBD	Environmental Baseline Database
EPA	Environmental Protection Agency
FAR	Federal Acquisition Regulation
FIFO	First In First Out
FWDA	Fort Wingate Depot Activity
GBL	Government Bill of Lading
GSA	General Services Agency
HAZMAT	Hazardous Material
HMRT	Hazardous Materials Response Team
ID	Intrusion Detection
IOC	Industrial Operations Command
IMPAC	International Merchants Purchase Authorized Card
KPI	Key Performance Indicator

Acronym	Definition
LRA	Local Reuse Authority
LTL	Less than TruckLoad
MSDS	Material Safety Data Sheet
MSRA	Mini Stock Record Account
MTMC	Military Transportation Management Command
MWR	Morale, Welfare, and Recreation
NAF	Non-Appropriated Funds
NEW	Net Explosive Weight
NOV	Notice of Violation
R3	Recycle, Recover, Reuse
RI/FS	Remedial Investigation/Feasibility Study
RRS	Rapid Response System
SDS	Standard Depot System
SPE	Strategic Planning Engine
SWOT	Strengths, Weaknesses, Opportunities, Threats
TEAD	Tooele Army Depot
TIP	Tooele Initiative Program
UGV	Unmanned Ground Vehicle

Appendix B

BMP Survey Team

Team Member	Activity	Function
Larry Robertson (812) 854-5336	Crane Division Naval Surface Warfare Center Crane, IN	Team Chairman
Dan Carlson (309) 782-6475	U.S. Army Industrial Operations Command Rock Island, IL	Technical Writer

Team 1

Ed Averill (717) 267-8400	Letterkenny Army Depot Chambersburg, PA	Team Leader
David Johnson (717) 267-8400	Letterkenny Army Depot Chambersburg, PA	
Don Livingston (812) 854-5157	Naval Surface Warfare Center Crane, IN	
Shari Wright (717) 267-8400	Letterkenny Army Depot Chambersburg, PA	

Team 2

Larry Halbig (317) 306-3838	Hughes Air Warfare Center Indianapolis, IN	Team Leader
Tim Donnelly (309) 782-3655	U.S. Army Industrial Operations Command Rock Island, IL	
Greta Gadson (703) 271-9055	Production Technology, Inc Arlington, VA	
Gerry Thomas (812) 854-1797	Naval Surface Warfare Center Crane, IN	

Team 3

Rick Purcell
(301) 403-8100

BMP Center of Excellence
College Park, MD

Team Leader

Bob Cale
(518) 266-5300

Watervliet Arsenal
Watervliet, NY

Louis Uptmor
(309) 782-7853

Rock Island Arsenal
Rock Island, IL

Bob York
(909) 273-4618

Naval Surface Warfare Center
Corona, CA

Appendix C

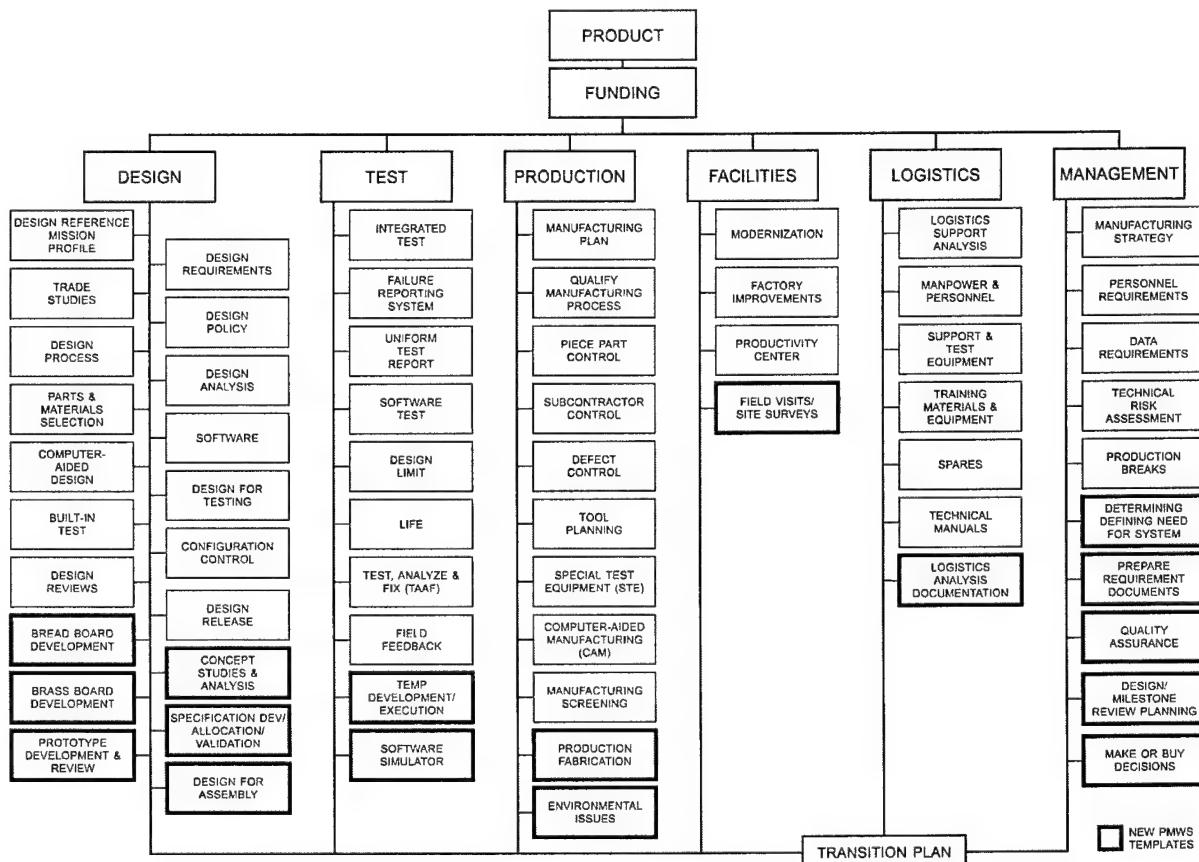
Critical Path Templates and BMP Templates

This survey was structured around and concentrated on the functional areas of design, test, production, facilities, logistics, and management as presented in the Department of Defense 4245.7-M, *Transition from Development to Production* document. This publication defines the proper tools—or templates—that constitute the critical path for a successful material acquisition program. It describes techniques for improving the acquisition

process by addressing it as an *industrial* process that focuses on the product's design, test, and production phases which are interrelated and interdependent disciplines.

The BMP program has continued to build on this knowledge base by developing 17 new templates that complement the existing DOD 4245.7-M templates. These BMP templates address new or emerging technologies and processes.

“CRITICAL PATH TEMPLATES FOR TRANSITION FROM DEVELOPMENT TO PRODUCTION”



Appendix D

BMPnet and the Program Manager's WorkStation

The BMPnet, located at the Best Manufacturing Practices Center of Excellence (BMPCOE) in College Park, Maryland, supports several communication features. These features include the Program Manager's WorkStation (**PMWS**), electronic mail and file transfer capabilities, as well as access to Special Interest Groups (SIGs) for specific topic information and communication. The BMPnet can be accessed through the World Wide Web (at <http://www.bmpcoe.org>), through free software that connects directly over the Internet or through a modem. The PMWS software is also available on CD-ROM.

PMWS provides users with timely acquisition and engineering information through a series of interrelated software environments and knowledge-based packages. The main components of PMWS are KnowHow, SpecRite, the Technical Risk Identification and Mitigation System (TRIMS), and the BMP Database.

KnowHow is an intelligent, automated program that provides rapid access to information through an intelligent search capability. Information currently available in KnowHow handbooks includes Acquisition Streamlining, Non-Development Items, Value Engineering, NAVSO P-6071 (Best Practices Manual), MIL-STD-2167/2168 and the DoD 5000 series documents. KnowHow cuts document search time by 95%, providing critical, user-specific information in under three minutes.

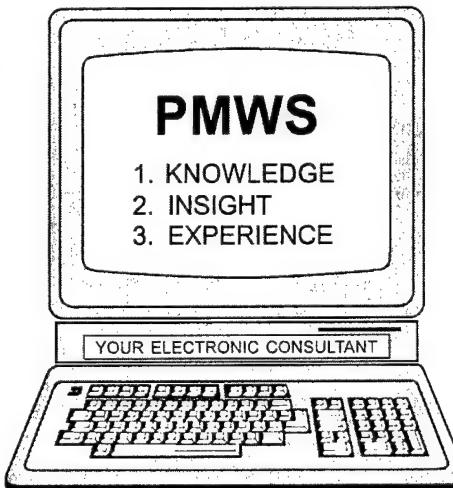
SpecRite is a performance specification generator based on expert knowledge from all uniformed services. This program guides acquisition person-

nel in creating specifications for their requirements, and is structured for the build/approval process. SpecRite's knowledge-based guidance and assistance structure is modular, flexible, and provides output in MIL-STD 961D format in the form of editable WordPerfect® files.

TRIMS, based on DoD 4245.7-M (the transition templates), NAVSO P-6071, and DoD 5000 event-oriented acquisition, helps the user identify and rank a program's high-risk areas. By helping the user conduct a full range of risk assessments throughout the acquisition process, TRIMS highlights areas where corrective action can be initiated before risks develop into problems. It also helps users track key project documentation from concept through production including goals, responsible personnel, and next action dates for future activities.

The **BMP Database** contains proven best practices from industry, government, and the academic communities. These best practices are in the areas of design, test, production, facilities, management, and logistics. Each practice has been observed, verified, and documented by a team of government experts during BMP surveys.

Access to the BMPnet through dial-in or on Internet requires a special modem program. This program can be obtained by calling the BMPnet Help Desk at (301) 403-8179 or it can be downloaded from the World Wide Web at <http://www.bmpcoe.org>. To receive a user/e-mail account on the BMPnet, send a request to helpdesk@bmpcoe.org.



Appendix E

Best Manufacturing Practices Satellite Centers

There are currently seven Best Manufacturing Practices (BMP) satellite centers that provide representation for and awareness of the BMP program to regional industry, government and academic institutions. The centers also promote the use of BMP with regional Manufacturing Technology Centers. Regional manufacturers can take advantage of the BMP satellite centers to help resolve problems, as the centers host informative, one-day regional workshops that focus on specific technical issues.

Center representatives also conduct BMP lectures at regional colleges and universities; maintain lists of experts who are potential survey team members; provide team member training; identify regional experts for inclusion in the BMPnet SIG e-mail; and train regional personnel in the use of BMP resources such as the BMPnet.

The seven BMP satellite centers include:

California

Chris Matzke

BMP Satellite Center Manager
Naval Warfare Assessment Division
Code QA-21, P.O. Box 5000
Corona, CA 91718-5000
(909) 273-4992
FAX: (909) 273-4123
cmatzke@bmpcoe.org

Jack Tamargo

BMP Satellite Center Manager
257 Cottonwood Drive
Vallejo, CA 94591
(707) 642-4267
FAX: (707) 642-4267
jtamargo@bmpcoe.org

District of Columbia

Margaret Cahill

BMP Satellite Center Manager
U.S. Department of Commerce
14th Street & Constitution Avenue, NW
Room 3876 BXA
Washington, DC 20230
(202) 482-8226/3795
FAX: (202) 482-5650
mcahill@bxa.doc.gov

Illinois

Thomas Clark

BMP Satellite Center Manager
Rock Valley College
3301 North Mulford Road
Rockford, IL 61114
(815) 654-5515
FAX: (815) 654-4459
adme3tc@rvcux1.rvc.cc.il.us

Michigan

Maureen H. Reilly

SAE/BMP Satellite Center Manager
3001 W. Big Beaver Road, Suite 320
Troy, MI 48084-3174
(724) 772-8564
FAX: (724) 776-0243
reilly@sae.org

Roy T. Trent

SAE/BMP Automotive Manufacturing Initiative
Manager
3001 W. Big Beaver Road, Suite 320
Troy, MI 48084-3174
(248) 652-8461
FAX: (248) 652-8662
bounder@ees.eesc.com

Pennsylvania

Sherrie Snyder

BMP Satellite Center Manager
MANTEC, Inc.
P.O. Box 5046
York, PA 17405
(717) 843-5054, ext. 225
FAX: (717) 854-0087
snyderss@mantec.org

Tennessee

Tammy Graham

BMP Satellite Center Manager
Lockheed Martin Energy Systems
P.O. Box 2009, Bldg. 9737
M/S 8091
Oak Ridge, TN 37831-8091
(423) 576-5532
FAX: (423) 574-2000
tgraham@bmpcoe.org

Appendix F

Navy Manufacturing Technology Centers of Excellence

The Navy Manufacturing Sciences and Technology Program established the following Centers of Excellence (COEs) to provide focal points for the development and technology transfer of new manufacturing processes and equipment in a cooperative environment with industry, academia, and Navy centers and laboratories. These COEs are consortium-structured for industry, academia, and government involvement in developing and implementing technologies. Each COE has a designated point of contact listed below with the individual COE information.

Best Manufacturing Practices Center of Excellence

The Best Manufacturing Practices Center of Excellence (BMPCOE) provides a national resource to identify and promote exemplary manufacturing and business practices and to disseminate this information to the U.S. Industrial Base. The BMPCOE was established by the Navy's BMP program, Department of Commerce's National Institute of Standards and Technology, and the University of Maryland at College Park, Maryland. The BMPCOE improves the use of existing technology, promotes the introduction of improved technologies, and provides non-competitive means to address common problems, and has become a significant factor in countering foreign competition.

Point of Contact:

Mr. Ernie Renner
Best Manufacturing Practices Center of Excellence
4321 Hartwick Road
Suite 400
College Park, MD 20740
(301) 403-8100
FAX: (301) 403-8180
ernie@bmpcoe.org

Center of Excellence for Composites Manufacturing Technology

The Center of Excellence for Composites Manufacturing Technology (CECMT) provides a national resource for the development and dissemination of composites manufacturing technology to defense contractors and subcontractors. The CECMT is managed by the GreatLakes Composites Consortium and represents a collaborative effort among industry, academia, and government to develop, evaluate, demonstrate, and test composites manufacturing technologies. The technical work is problem-driven to reflect current and future Navy needs in the composites industrial community.

Point of Contact:

Dr. Roger Fountain
Center of Excellence for Composites Manufacturing Technology
103 Trade Zone Drive
Suite 26C
West Columbia, SC 29170
(803) 822-3705
FAX: (803) 822-3730
rfglcc@glcc.org

Electronics Manufacturing Productivity Facility

The Electronics Manufacturing Productivity Facility (EMPF) identifies, develops, and transfers innovative electronics manufacturing processes to domestic firms in support of the manufacture of affordable military systems. The EMPF operates as a consortium comprised of industry, university, and government participants, led by the American Competitiveness Institute under a CRADA with the Navy.

Point of Contact:

Mr. Alan Criswell
Electronics Manufacturing Productivity Facility
Plymouth Executive Campus
Bldg 630, Suite 100
630 West Germantown Pike
Plymouth Meeting, PA 19462
(610) 832-8800
FAX: (610) 832-8810
<http://www.engriupui.edu/empf/>

National Center for Excellence in Metalworking Technology

The National Center for Excellence in Metalworking Technology (NCEMT) provides a national center for the development, dissemination, and implementation of advanced technologies for metalworking products and processes. The NCEMT, operated by Concurrent Technologies Corporation, helps the Navy and defense contractors improve

manufacturing productivity and part reliability through development, deployment, training, and education for advanced metalworking technologies.

Point of Contact:

Mr. Richard Henry

National Center for Excellence in Metalworking Technology
1450 Scalp Avenue
Johnstown, PA 15904-3374
(814) 269-2532
FAX: (814) 269-2799
henry@ctc.com

Navy Joining Center

The Navy Joining Center (NJC) is operated by the Edison Welding Institute and provides a national resource for the development of materials joining expertise and the deployment of emerging manufacturing technologies to Navy contractors, subcontractors, and other activities. The NJC works with the Navy to determine and evaluate joining technology requirements and conduct technology development and deployment projects to address these issues.

Point of Contact:

Mr. David P. Edmonds
Navy Joining Center
1100 Kinnear Road
Columbus, OH 43212-1161
(614) 487-5825
FAX: (614) 486-9528
dave_edmonds@ewi.org

Energetics Manufacturing Technology Center

The Energetics Manufacturing Technology Center (EMTC) addresses unique manufacturing processes and problems of the energetics industrial base to ensure the availability of affordable, quality energetics. The focus of the EMTC is on process technology with a goal of reducing manufacturing costs while improving product quality and reliability. The COE also maintains a goal of development and implementation of environmentally benign energetics manufacturing processes.

Point of Contact:

Mr. John Brough

Energetics Manufacturing Technology Center
Indian Head Division
Naval Surface Warfare Center
Indian Head, MD 20640-5035
(301) 743-4417
DSN: 354-4417
FAX: (301) 743-4187
mt@command.nosih.sea06.navy.mil

Manufacturing Science and Advanced Materials Processing Institute

The Manufacturing Science and Advanced Materials Processing Institute (MS&I) is comprised of three centers including the National Center for Advanced Drivetrain Technologies (NCADT), The Surface Engineering Manufacturing Technology Center (SEMTC), and the Laser Applications Research Center (LaserARC). These centers are located at The Pennsylvania State University's Applied Research Laboratory. Each center is highlighted below.

Point of Contact for MS&I:

Mr. Henry Watson
Manufacturing Science and Advanced Materials Processing Institute
ARL Penn State
P.O. Box 30
State College, PA 16804-0030
(814) 865-6345
FAX: (814) 863-1183
hew2@psu.edu

- National Center for Advanced Drivetrain Technologies**

The NCADT supports DoD by strengthening, revitalizing, and enhancing the technological capabilities of the U.S. gear and transmission industry. It provides a site for neutral testing to verify accuracy and performance of gear and transmission components.

Point of Contact for NCADT:

Dr. Suren Rao
NCADT/Drivetrain Center
ARL Penn State
P.O. Box 30
State College, PA 16804-0030
(814) 865-3537
FAX: (814) 863-6185
http://www.arl.psu.edu/drivetrain_center.html/

- **Surface Engineering Manufacturing Technology Center**

The SEMTC enables technology development in surface engineering—the systematic and rational modification of material surfaces to provide desirable material characteristics and performance. This can be implemented for complex optical, electrical, chemical, and mechanical functions or products that affect the cost, operation, maintainability, and reliability of weapon systems.

Point of Contact for SEMTC:
Dr. Maurice F. Amateau
SEMTC/Surface Engineering Center
P.O. Box 30
State College, PA 16804-0030
(814) 863-4214
FAX: (814) 863-0006
http://www.arl.psu.edu/divisions/arl_org.html

- **Laser Applications Research Center**

The LaserARC is established to expand the technical capabilities of DOD by providing access to high-power industrial lasers for advanced material processing applications. LaserARC offers basic and applied research in laser-material interaction, process development, sensor technologies, and corresponding demonstrations of developed applications.

Point of Contact for LaserARC:
Mr. Paul Denney
Laser Center
ARL Penn State
P.O. Box 30
State College, PA 16804-0030
(814) 865-2934
FAX: (814) 863-1183
http://www.arl.psu.edu/divisions/arl_org.html

- **Gulf Coast Region Maritime Technology Center**

The Gulf Coast Region Maritime Technology Center (GCRMTC) is located at the University of New Orleans and will focus primarily on product developments in support of the U.S. shipbuilding industry. A sister site at Lamar University in Orange, Texas will focus on process improvements.

Point of Contact:
Dr. John Crisp
Gulf Coast Region Maritime Technology Center
University of New Orleans
Room N-212
New Orleans, LA 70148
(504) 286-3871
FAX: (504) 286-3898

Appendix G

Completed Surveys

As of this publication, 100 surveys have been conducted and published by BMP at the companies listed below. Copies of older survey reports may be obtained through DTIC or by accessing the BMPnet. Requests for copies of recent survey reports or inquiries regarding the BMPnet may be directed to:

Best Manufacturing Practices Program
4321 Hartwick Rd., Suite 400
College Park, MD 20740
Attn: Mr. Ernie Renner, Director
Telephone: 1-800-789-4267
FAX: (301) 403-8180
ernie@bmpcoe.org

1985	Litton Guidance & Control Systems Division - Woodland Hills, CA
1986	Honeywell, Incorporated Undersea Systems Division - Hopkins, MN (Alliant TechSystems, Inc.) Texas Instruments Defense Systems & Electronics Group - Lewisville, TX General Dynamics Pomona Division - Pomona, CA Harris Corporation Government Support Systems Division - Syosset, NY IBM Corporation Federal Systems Division - Owego, NY Control Data Corporation Government Systems Division - Minneapolis, MN
1987	Hughes Aircraft Company Radar Systems Group - Los Angeles, CA ITT Avionics Division - Clifton, NJ Rockwell International Corporation Collins Defense Communications - Cedar Rapids, IA UNISYS Computer Systems Division - St. Paul, MN (Paramax)
1988	Motorola Government Electronics Group - Scottsdale, AZ General Dynamics Fort Worth Division - Fort Worth, TX Texas Instruments Defense Systems & Electronics Group - Dallas, TX Hughes Aircraft Company Missile Systems Group - Tucson, AZ Bell Helicopter Textron, Inc. - Fort Worth, TX Litton Data Systems Division - Van Nuys, CA GTE C ³ Systems Sector - Needham Heights, MA
1989	McDonnell-Douglas Corporation McDonnell Aircraft Company - St. Louis, MO Northrop Corporation Aircraft Division - Hawthorne, CA Litton Applied Technology Division - San Jose, CA Litton Amecom Division - College Park, MD Standard Industries - LaMirada, CA Engineered Circuit Research, Incorporated - Milpitas, CA Teledyne Industries Incorporated Electronics Division - Newbury Park, CA Lockheed Aeronautical Systems Company - Marietta, GA Lockheed Corporation Missile Systems Division - Sunnyvale, CA Westinghouse Electronic Systems Group - Baltimore, MD General Electric Naval & Drive Turbine Systems - Fitchburg, MA Rockwell International Corporation Autonetics Electronics Systems - Anaheim, CA TRICOR Systems, Incorporated - Elgin, IL
1990	Hughes Aircraft Company Ground Systems Group - Fullerton, CA TRW Military Electronics and Avionics Division - San Diego, CA MechTronics of Arizona, Inc. - Phoenix, AZ Boeing Aerospace & Electronics - Corinth, TX Technology Matrix Consortium - Traverse City, MI Textron Lycoming - Stratford, CT

1991	<i>Resurvey of Litton Guidance & Control Systems Division</i> - Woodland Hills, CA Norden Systems, Inc. - Norwalk, CT Naval Avionics Center - Indianapolis, IN United Electric Controls - Watertown, MA Kurt Manufacturing Co. - Minneapolis, MN MagneTek Defense Systems - Anaheim, CA Raytheon Missile Systems Division - Andover, MA AT&T Federal Systems Advanced Technologies and AT&T Bell Laboratories - Greensboro, NC and Whippany, NJ <i>Resurvey of Texas Instruments Defense Systems & Electronics Group</i> - Lewisville, TX
1992	Tandem Computers - Cupertino, CA Charleston Naval Shipyard - Charleston, SC Conax Florida Corporation - St. Petersburg, FL Texas Instruments Semiconductor Group Military Products - Midland, TX Hewlett-Packard Palo Alto Fabrication Center - Palo Alto, CA Watervliet U.S. Army Arsenal - Watervliet, NY Digital Equipment Company Enclosures Business - Westfield, MA and Maynard, MA Computing Devices International - Minneapolis, MN <i>(Resurvey of Control Data Corporation Government Systems Division)</i> Naval Aviation Depot Naval Air Station - Pensacola, FL
1993	NASA Marshall Space Flight Center - Huntsville, AL Naval Aviation Depot Naval Air Station - Jacksonville, FL Department of Energy Oak Ridge Facilities (Operated by Martin Marietta Energy Systems, Inc.) - Oak Ridge, TN McDonnell Douglas Aerospace - Huntington Beach, CA Crane Division Naval Surface Warfare Center - Crane, IN and Louisville, KY Philadelphia Naval Shipyard - Philadelphia, PA R. J. Reynolds Tobacco Company - Winston-Salem, NC Crystal Gateway Marriott Hotel - Arlington, VA Hamilton Standard Electronic Manufacturing Facility - Farmington, CT Alpha Industries, Inc. - Methuen, MA
1994	Harris Semiconductor - Melbourne, FL United Defense, L.P. Ground Systems Division - San Jose, CA Naval Undersea Warfare Center Division Keyport - Keyport, WA Mason & Hanger - Silas Mason Co., Inc. - Middletown, IA Kaiser Electronics - San Jose, CA U.S. Army Combat Systems Test Activity - Aberdeen, MD Stafford County Public Schools - Stafford County, VA
1995	Sandia National Laboratories - Albuquerque, NM Rockwell Defense Electronics Collins Avionics & Communications Division - Cedar Rapids, IA <i>(Resurvey of Rockwell International Corporation Collins Defense Communications)</i> Lockheed Martin Electronics & Missiles - Orlando, FL McDonnell Douglas Aerospace (St. Louis) - St. Louis, MO <i>(Resurvey of McDonnell-Douglas Corporation McDonnell Aircraft Company)</i> Dayton Parts, Inc. - Harrisburg, PA Wainwright Industries - St. Peters, MO Lockheed Martin Tactical Aircraft Systems - Fort Worth, TX <i>(Resurvey of General Dynamics Fort Worth Division)</i> Lockheed Martin Government Electronic Systems - Moorestown, NJ Sacramento Manufacturing and Services Division - Sacramento, CA JLG Industries, Inc. - McConnellsburg, PA
1996	City of Chattanooga - Chattanooga, TN Mason & Hanger Corporation - Pantex Plant - Amarillo, TX Nascote Industries, Inc. - Nashville, IL Weirton Steel Corporation - Weirton, WV NASA Kennedy Space Center - Cape Canaveral, FL Department of Energy, Oak Ridge Operations - Oak Ridge, TN

1997

Headquarters, U.S. Army Industrial Operations Command - Rock Island, IL
SAE International and Performance Review Institute - Warrendale, PA
Polaroid Corporation - Waltham, MA
Cincinnati Milacron, Inc. - Cincinnati, OH
Lawrence Livermore National Laboratory - Livermore, CA
Sharretts Plating Company, Inc. - Emigsville, PA
Thermacore, Inc. - Lancaster, PA
Rock Island Arsenal - Rock Island, IL
Northrop Grumman Corporation - El Segundo, CA
(Resurvey of Northrop Corporation Aircraft Division)
Letterkenny Army Depot - Chambersburg, PA
Elizabethtown College - Elizabethtown, PA
Tooele Army Depot - Tooele, UT
